

ESD ACCESSION LIST

ESTI Call No. AL 49380Copy No. 1 of 1 cys.

ESD RECORD COPY

RETURN TO
SCIENTIFIC & TECHNICAL INFORMATION DIVISION
(ESTI), BUILDING 1211

Technical Note

1966-4

BASELINE
A Man-Machine Program
for Data AnalysisG. M. Shannon
H. L. Kasnitz
J. A. Drumheller

20 January 1966

Prepared for the Advanced Research Projects Agency
under Electronic Systems Division Contract AF 19(628)-5167 by

Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Lexington, Massachusetts



ESRL

AD 628494

The work reported in this document was performed at Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology. This research is a part of Project DEFENDER, which is sponsored by the U.S. Advanced Research Projects Agency of the Department of Defense; it is supported by ARPA under Air Force Contract AF 19(628)-5167 (ARPA Order 600).

This report may be reproduced to satisfy needs of U.S. Government agencies.

Distribution of this document is unlimited.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

BASELINE: A MAN-MACHINE PROGRAM FOR DATA ANALYSIS

G. M. SHANNON

H. L. KASNITZ

Group 21

J. A. DRUMHELLER

Adams Associates

TECHNICAL NOTE 1966-4

20 JANUARY 1966

LEXINGTON

MASSACHUSETTS

ABSTRACT

BASELINE was designed to perform a statistical analysis of radar pulse data previously read by the Laboratory's high precision computer controlled film reader. A computer controlled display oscilloscope, a light pen and a set of function coded sense switches provide a real time interface between an analyst and the data reduction program in the computer. The computer performs all necessary display, computation and outputting functions. All operations are under direct control of the analyst. He sets the operating criteria, exercises the required judgments and steers the program through the required analysis.

Analytical results are quickly available and rapidly documented. Output consists of a statistical distribution of the input data displayed on a large oscilloscope. This display may easily be documented photographically. Key parameters describing the statistical distribution may be output on the typewriter at the command of the analyst. A very large saving in data reduction time results since the necessity of repeated test runs through a large computer and subsequent study of the numerical printouts is eliminated.

Accepted for the Air Force
Franklin C. Hudson
Chief, Lincoln Laboratory Office

TABLE OF CONTENTS

Abstract	iii
I. Introduction	1
II. The Purpose of the Program	3
III. General Description of the Program	5
IV. Detailed Description of the Program	10
V. Operating Procedures	14
VI. Input Tape Format	20
VII. APPENDIX: Flow Charts and Program Listing	23

I. Introduction

BASELINE performs a statistical analysis of radar pulse data. The program provides an effective interface between the analyst and the mathematical reduction in the computer. The presence of the analyst is required.

The program uses the techniques of computer graphics to present both raw data and processed data to the analyst. Primary control is exercised by the analyst with a light pen and a set of function coded sense switches.

All processing takes place directly under the analyst's control. He may intervene in the processing at any point. The required outputs may be documented immediately upon completion of the analysis. The reduction process is continuous from raw data entry to final documentation. A production run of data typically requires about 15 minutes to complete. This program replaces a series of test data runs previously handled on the IBM 7094 computer which, because of their necessarily discontinuous nature, required about four days to complete and analyze.

This program was written for the Digital Equipment Company PDP-1 computer equipped with 16,000 words of storage. The word length of this machine is 18 bits. The primary man-machine interface is accomplished with the DEC Type 340 computer controlled display oscilloscope, which is used for all the displays in the program. A light pen is used by the analyst to provide direct graphical communication with the program. The six sense switches and the eighteen test word switches located on the computer control panel are paralleled and brought out to a special control box which may be conveniently moved about at the oscilloscope control station. These switches are equipped with indicator lights and accept overlay cards which are marked in terms of the program functions which they control. These switches, function coded by the program, form a primary communication medium with the data reduction program so that the operating analyst need not be familiar with the details of the computer or its programming.

The control station is shown in Fig. 1. The oscilloscope, the light pen and the control box form the primary man-machine interface. The input-output typewriter is

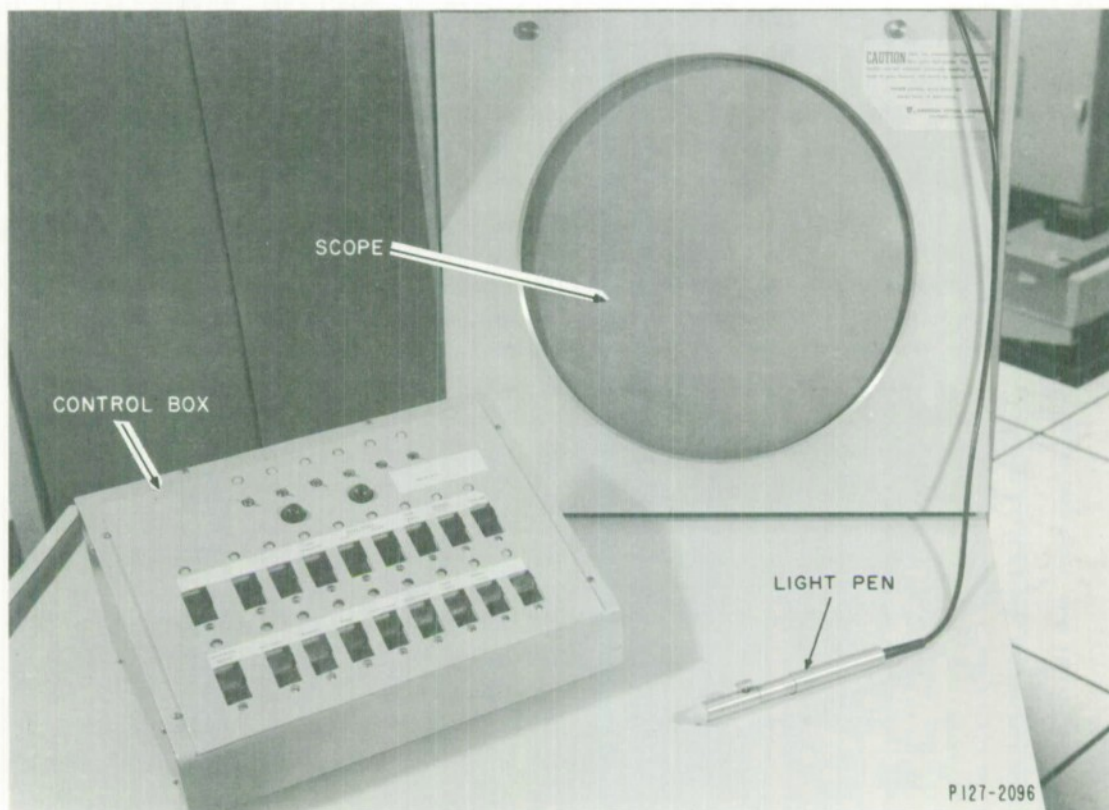


Fig. 1. The Computer Control Station.

also available as a two way interface but its use is limited to title modification on the display and as a selectable printer for typed output.

It has been found that an analyst familiar with the data reduction problem can learn to use BASELINE in about 15 minutes.

The control box is activated by the computer program through a special instruction so that the programmer may make the control box available to the analyst and still preserve the normal use of the panel switches if he so desires.

The graphical display is fully titled. Control functions are identified by title and are accessible to light pen operation. Appropriate parameters of the statistical analysis are continuously updated and displayed.

Graphical documentation is available by photographing the display. Typewriter printout of the statistical parameters and the identification data form the normal output. At the option of the analyst, this documentation may be recorded on high speed punched tape for later printing on a Flexowriter.

II. The Purpose of the Program

An automatic computer controlled film reader is regularly used at the Laboratory to digitize radar pulse data recorded on film from the face of a cathode ray tube. Data is recorded in rows or "channels" on a continuously moving 35 mm film. Up to four channels of data may be recorded on one film and the reading of the data is completely automatic. A section of film showing radar pulses as recorded from the CRT is shown in Fig. 2. The system has successfully recorded data with bandwidths up to 17 Mcps.

These digitized pulse data are analyzed by a series of programs written for the IBM 7094 computer. Before a meaningful analysis can be accomplished it is necessary to determine the position of the leading edge of each pulse return with respect to its location on the digitized oscilloscope trace. A pattern recognition program written for the IBM 7094 performs this function by passing a mathematical filter through each recorded pulse. This FILTER program requires a threshold number for proper operation. The threshold number is based on the noise statistics of the baseline of the

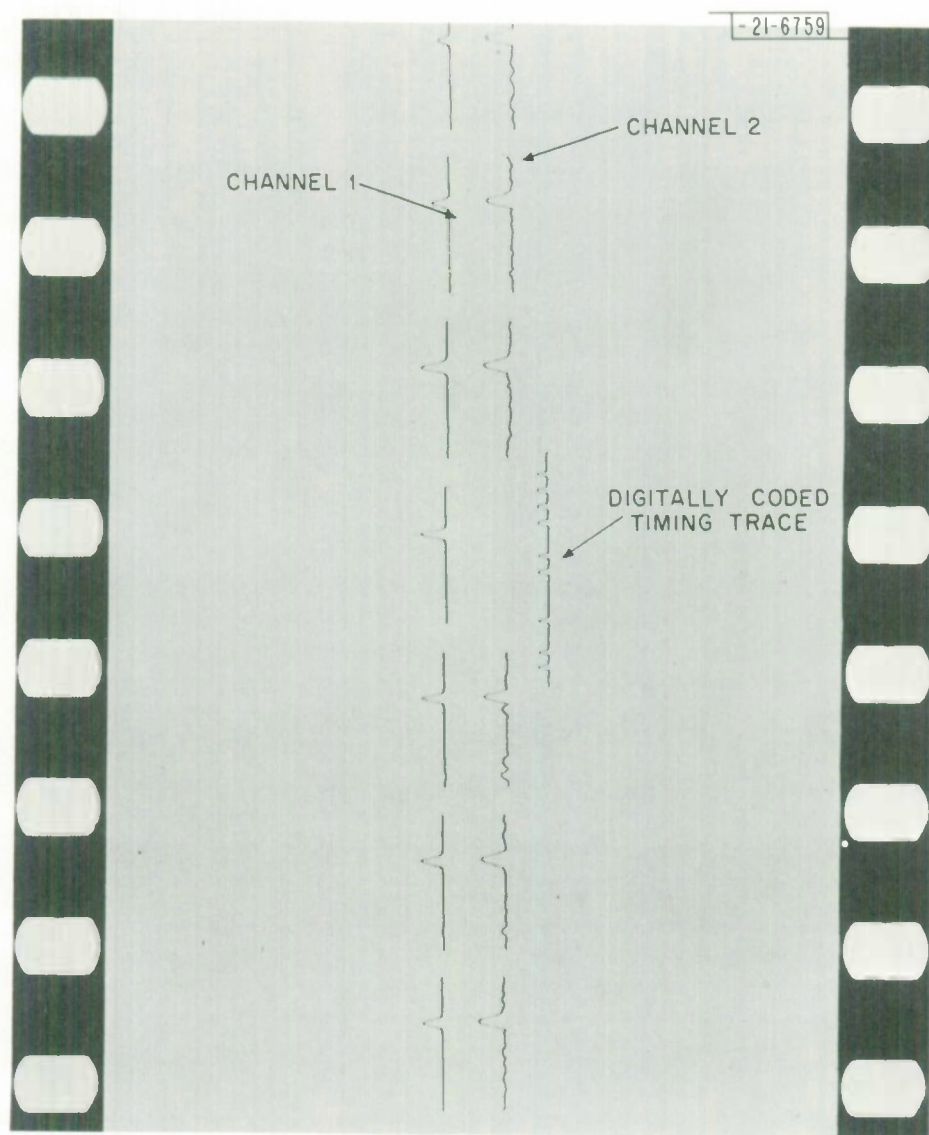


Fig. 2. Typical Radar Film.

traces which also contain the pulses. BASELINE is designed primarily to perform a statistical analysis to obtain this threshold number.

The region of the data traces to be used to obtain the baseline noise statistics is selected by the analyst. For noise statistics, areas of the traces that do not include the pulses are selected. The analyst may, however, select the pulse data for analysis and the program will then produce pulse statistics. This feature has proven particularly useful in handling data recorded in phase quadrature as it allows a separate statistical study of each quadrature channel so that any inequalities in gain settings on the quadrature channels can be measured. The subsequent analysis is then adjusted to account for any measured gain difference in the quadrature data channels.

The use of BASELINE allows one to enter a series of extensive and time consuming 7094 programs with high confidence that the operating parameters of these programs have been properly chosen to match the particular set of data that is being processed.

III. General Description of the Program

The output data from the film reader recorded on magnetic tape serves as input to BASELINE. This same tape is later used as input data to the 7094 reduction programs.

Reading BASELINE into the PDP-1 computer starts the sequence of operations. The program first reads the title information recorded on the film reader output tape and displays this as a title on the CRT. This includes the test identification numbers, the type of data read and time codes appropriate to the experimental data being studied.

The analyst then selects a data channel with the light pen. One of up to four channels of data may be selected. The channels are defined on the original filmed record as shown in Fig. 2.

The raw data is introduced into the computer and displayed trace by trace for the inspection of the analyst. Successive traces may be displayed manually or automatic sequencing is available at several selectable rates. In this way the raw data

traces may be sequentially examined. The computer counts the traces displayed and adjusts the time reference.

When a statistical analysis is desired the analyst sets one or more pairs of gates on the data trace to designate those regions that are to be included in the statistical analysis (Fig. 3). The program then plots a histogram of the distribution of the deflections (from the calculated zero deflection position as determined by the film reader) for each data point within the designated gates (Fig. 4). The traces typically contain about 200 data points. The data from the trace is entered into the analysis subsequent to viewing so that the analyst may reject a trace when he wishes without upsetting the statistical analysis. The distribution of trace displacements is updated and plotted on a trace-by-trace basis. The histogram is renormalized for every entry and the limits of the distribution are automatically rescaled. The program is designed to handle both bipolar and unipolar data.

The program continuously displays the total number of traces handled, the total number of data points used in the statistical analysis, the mean and the standard deviation of the accumulated data. On demand, the computer will calculate the Gaussian distribution with the same standard deviation and mean as the experimental data and display this plotted function along with the measured distribution (Fig. 5).

The analyst may determine when a sufficient amount of data has been included in the analysis by noting when the experimentally determined distribution has become stationary. Documentation of the significant statistical parameters is then initiated by the analyst using a control switch. The analyst may also designate any single point on the measured distribution curve with a light pen. The value of the integral distribution about the mean up to the selected value of trace displacement is then calculated and included in the documentation.

The program is designed with "fail safe" features. An error in the operating sequence will stop the program. An error message will appear on the display to tell the analyst how to rectify the error.

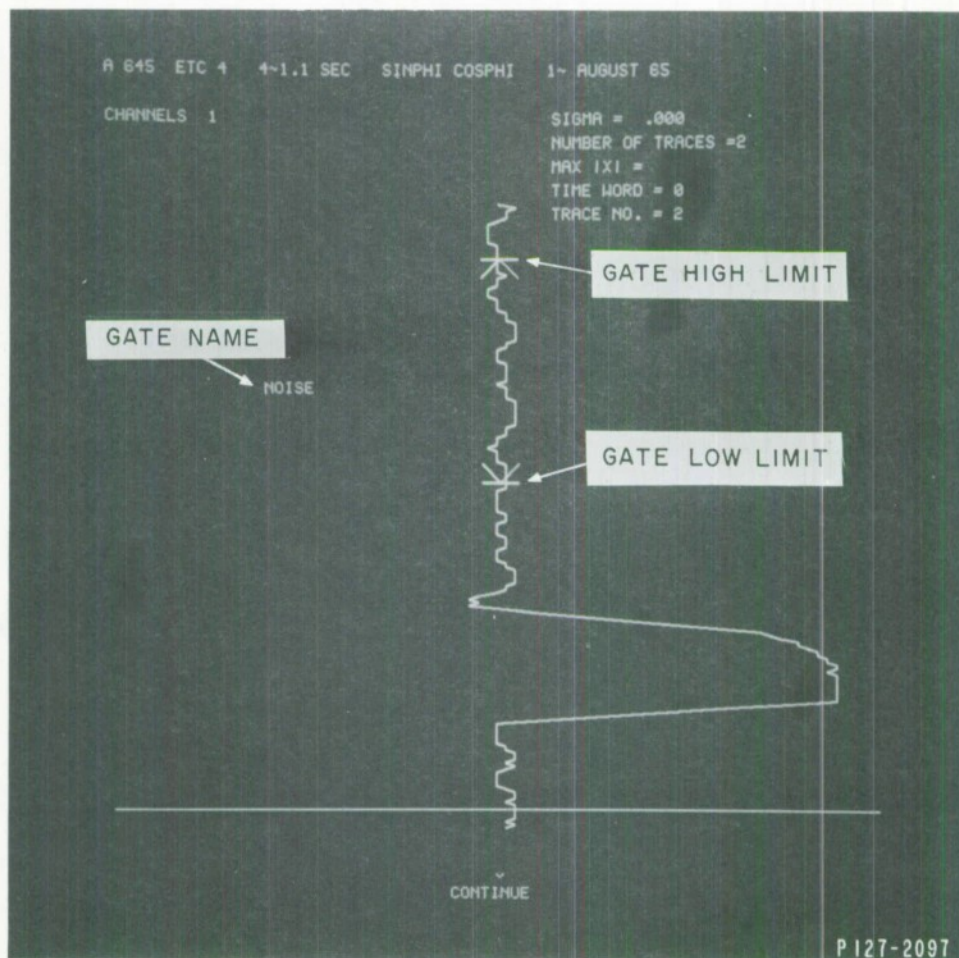


Fig. 3. Radar Data Trace Showing Typical Gate Limits for a BASELINE Distribution of Analysis.

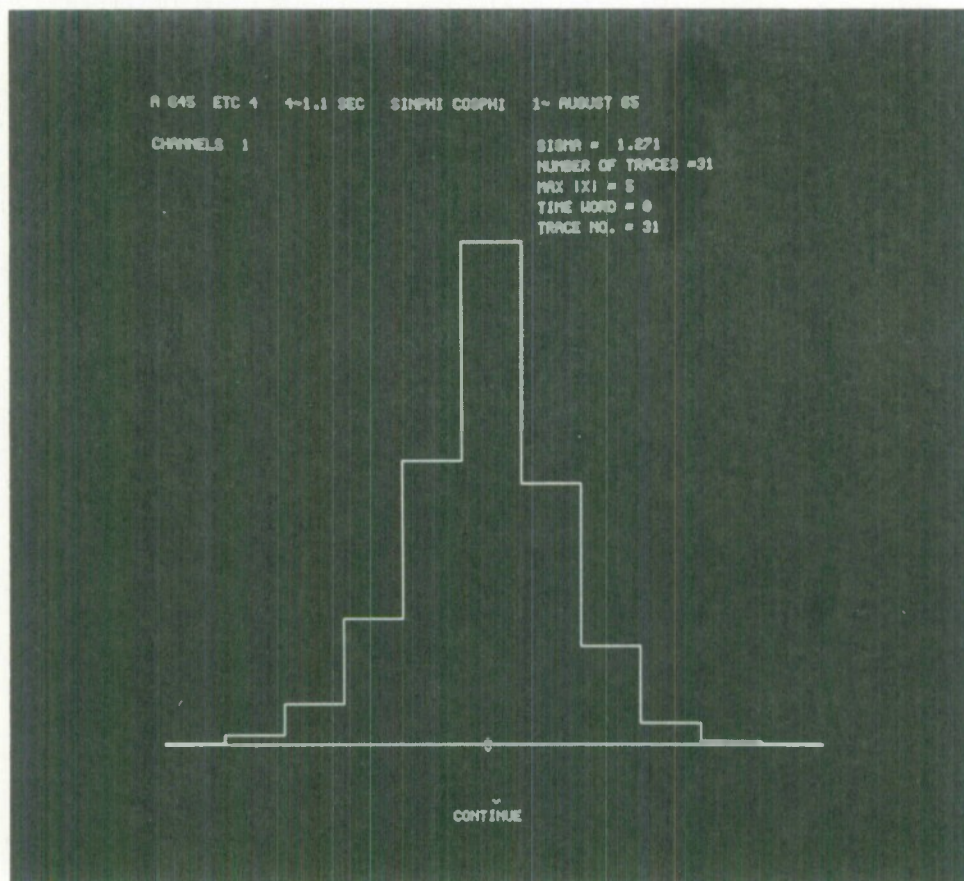


Fig. 4. Typical Distribution of "Noise" Data from 31 Traces.

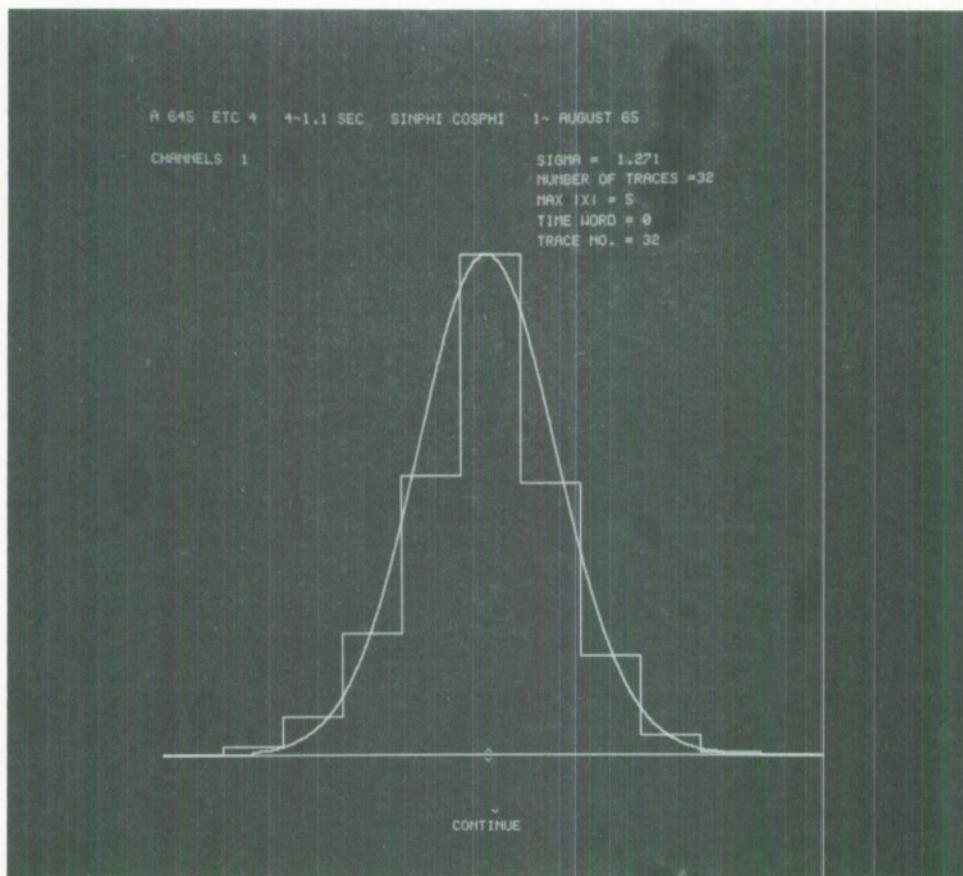


Fig. 5. Distribution of Fig. 4 with a Theoretical Gaussian of the Same Mean and Standard Deviation Superimposed.

IV. Detailed Description of the Program

The data are read into the computer and right-justified by a division of 2^8 . The program is capable of handling data values of any size provided they do not exceed one register, that is, one 18-bit word. However, the core area allocated to the cumulative frequency tally table used to produce the histogram has been limited to a maximum range of 915 decimal units or between ± 457 . This range was chosen since, after allowing for margins, there are 915 decimal increments across the Type 340 scope, thereby permitting only 915 distinct quantum increments, or cells, in the histogram display. If it is necessary to display a larger range of data within the 915 increments available, the data must be regrouped or granulated. To do this the contents of each two consecutive cells in the original tally table are added together to form one new cell. This process is repeated until the entire range of the data can be accommodated in the 915 available cells.

A section of the tally table before and after regrouping is shown in Table 1.

After the data have been read into the computer and the trace has been displayed, the operator may designate up to seven different areas of the data trace to be analyzed. These areas can be overlapping, entirely within one another, or completely different. It should be noted, however, that data contained within more than one area will be accordingly weighted.

The total set of N data points (x_n) will be collected in the cumulative frequency tally table which covers the region:

$$x_{-1} \leq x_n \leq x_I$$

Such that:

$$f_i = f(x_i)$$

TABLE I

Tally Table Before Regrouping

Histogram Increments	Populations
-6;	0
-5;	1
-4;	3
-3;	4
-2;	7
-1;	8
0;	12
+1;	9
+2;	6
+3;	3
+4;	2
+5;	2

Tally Table After Regrouping

-5, -6→-3;	1+0=1
-3, -4→-2;	4+3=7
-1, -2→-1;	8+7=15
0, +1→ 0;	12+9=21
+2, +3→+1;	6+3=9
+4, +5→+2;	2+2=4

where f_i is the population in the i th cell or quantum increment, and x_i is the value of the i th cell or quantum increment. Note that:

$$N = \sum_{-I}^I f_i$$

This histogram is continuously displayed and modified as each new trace is read in, but the display does not include the data in the trace being viewed. In this manner the operator can, if the data are bad, skip a trace at any time by means of a button on the control box and in no way affect the value of the histogram.

The standard deviation of the distribution is also continuously displayed and updated. It is calculated with the formula:

$$\sigma = \sqrt{\frac{\sum x_i^2 - \frac{(\sum x_i)^2}{N}}{N}}$$

The square root is approximated by:

$$a(n+1) = \left(\frac{Y}{a(n)} + a(n) \right) / 2$$

where the initial approximation for $a(1)$ is equal to $Y/2$. This approximation is continued until,

$$\begin{aligned} a(n+1) - a(n) &= 0 \quad \text{or} \\ a(n+1) &= a(20). \end{aligned}$$

For these calculations double and quadruple precision mathematical routines are used.

For the sum of the x squared values, four 18-bit registers have been reserved so this value can be as large as $2^{70} - 1$. For the sum of the x values, two 18-bit registers have been reserved so this value can be as large as $2^{35} - 1$. This also holds for the registers containing the total number of points analyzed. The entire tally table is also double-precision, thereby enabling the frequency for any individual value to be as large as $2^{35} - 1$. The standard deviation and the average are each allowed only one register since neither value is expected to exceed the maximum data value within a register. These two values and their associated probability values are multiplied by 1000, thereby allowing for three places of accuracy after the decimal point.

Other information continuously displayed is the total number of points analyzed, the maximum absolute value of x, and the first and second time words of the trace then being displayed. The analyst may also display a theoretical normal distribution superimposed on the histogram with the mean given by

$$\bar{x} = \frac{\sum_{-I}^{+I} (f_i) (x_i)}{N} = \frac{\sum_{1}^N x_n}{N}$$

and the standard deviation as defined above.

The values for the theoretical normal curve are derived from the formula

$$G(x_i) = \frac{1}{\sqrt{2\pi}} \cdot \frac{1}{\sigma} \cdot e^{-\frac{(x_i - \bar{x})^2}{2\sigma^2}}$$

where

$$e^{-x} \sim \frac{1}{[1 + a(1) \cdot x + a(2) \cdot x^2 + a(3) \cdot x^3]^4} \quad *$$

*This approximation is from Approximations for Digital Computers by Cecil Hastings, p. 182.

with:

$$a(1) = .2507213$$

$$a(2) = .0292732$$

$$a(3) = .0038278$$

with an error usually better than $\pm .0002$.

The analyst can stop the program at any time and delete any area of calculation or change any given data area. He also can stop the calculations and then select an x value on the histogram and/or document what he has done so far, skip to the next file, return to the beginning of the file he is viewing, or simply continue from where he left off.

The document option provides either an on-line typeout or a punched paper-tape output. Both include the following: the title of the file; the channel number viewed; the number of data points analyzed; the value of the mean of the distribution; the probability of the mean; the value of the standard deviation of the distribution; the integral probability for $\pm 1\sigma$, $\pm 2\sigma$, and $\pm 3\sigma$; the granularity of the data; and the maximum and minimum data values. If an x value had been selected on the histogram before documentation, the documentation will also include the displacement from the mean of the selected x value and the integral probability of this selected bandwidth about the mean.

A diagram of the push-button panel is shown in Fig. 6.

V. Operating Procedures

1. Load data tape on tape drive and select #5.
2. Turn off all test-word switches, address switches and the extended switch.
3. a) Put up module switch 2 and read in paper-tape binary for module 2;
b) put up module switch 1 and read in paper-tape binary for module 1; c) put down all module switches and read in paper-tape binary for module 0.

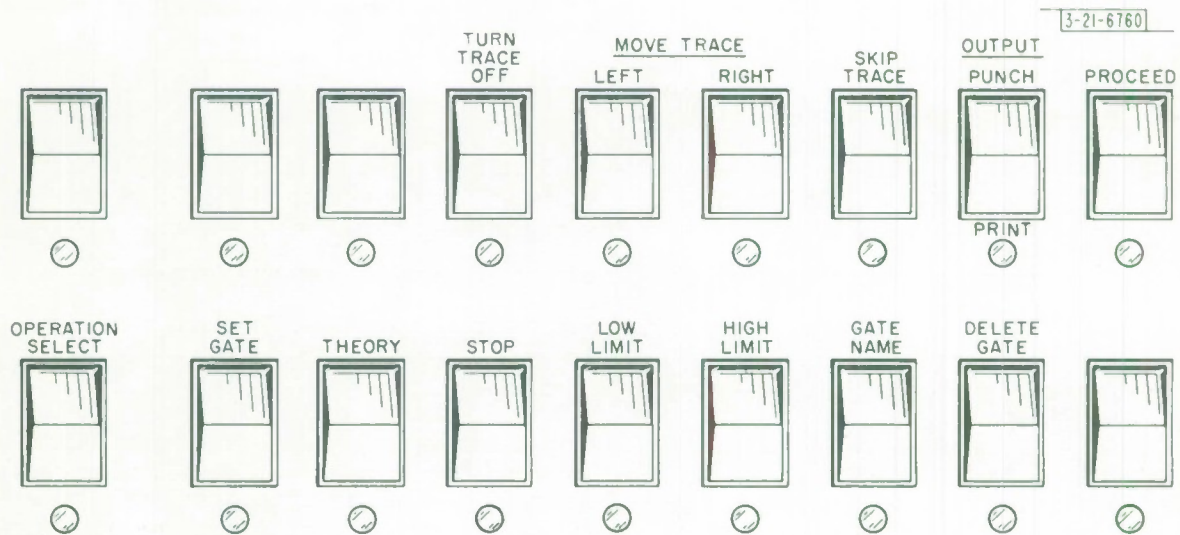


Fig. 6. Control Box Switch Assignments.

CONTINUE will terminate input from the typewriter; c) a new title will then be displayed.

TYPE OUT - a light-pen response will cause the title and the channel number selected to be typed out for a permanent record.

CONTINUE - a) a light-pen response before a channel selection is made will cause an error message to be displayed; b) a light-pen response after typing in a new title will terminate input from the typewriter; c) a light-pen response with set title and an appropriate channel number selected will cause the first trace in the selected channel to be read into the computer and displayed.

6. The trace display options are listed below and are illustrated in Fig. 3.

A. Change the status of the PROCEED button and the next trace in the selected channel will be read in and displayed. No calculations are being done.

B. Determine the areas of the trace that are to be analyzed by turning on the SET GATE button on the panel.

1. Turn on the GATE NAME button also.

a. Track the raster with the light-pen to the desired area of the scope.

b. Type in a name no longer than six characters for that limit set, and terminate with a carriage return.

c. Turn off the GATE NAME button.

2. Turn on the HIGH LIMIT button also.

a. A light-pen response on the trace will cause an upper-limit caret to be displayed at the point of response and set the upper limit of the area to be analyzed.

b. Turn off the HIGH LIMIT button.

3. Turn on the LOW LIMIT button.

a. A light-pen response on the trace will cause a lower limit caret to be displayed at the point of response and will set the lower limit of the area to be analyzed.

- b. Turn off the LOW LIMIT button
 - 4. Turn off the main SET GATE button.
 - a. If this button is turned off before a proper set definition is made, an error message will be displayed. Turn button back on and continue.
 - b. If more than one set of limit areas is desired, the above process can be repeated for as many as seven different areas. Each separate area definition is set by turning off the main SET GATE button.
- 7. To start the calculations:
 - A. A change in the status of the PROCEED button will cause:
 - 1. values in the designated areas of the trace to be ordered into a cumulative frequency tally table and displayed in the form of a histogram;
 - 2. sigma to be calculated and displayed; and
 - 3. the average to be calculated and displayed by means of a caret along the baseline.
 - B. The status of the time counter can be changed from the initialized mode of operation, frame by frame, by turning on the OPERATION SELECT button. The different options will be displayed as light buttons.
 - 1. "Frame" will have a caret over it designating the mode of operation currently in use. This means that a change in the PROCEED button is necessary before the computer will continue to the next frame.
 - 2. "Slow" - a light-pen response will cause a caret to be displayed over the word.
 - 3. "Moderate" - same as 2 above.
 - 4. "Fast" - same as 2 above.
 - 5. When the OPERATION SELECT button is turned off, the calculations will continue under program control in the mode of operation designated by the caret when the button was turned off.
- 8. To delete the limit areas:

A. turn on the SET GATE and DELETE GATE buttons.

1. The calculation will stop.

2. The names of the limit areas will be displayed.

3. A light-pen response on either the upper or lower limit caret of the area to be deleted will cause a caret to be placed over the name of the area. The area can be changed simply by hitting a different limit caret until the desired area name has a caret over it.

4. A light-pen response on anything below the baseline will cause all carets over names to disappear.

5. When the DELETE GATE and SET GATE buttons are turned off, the set deleted will be the one whose name has a caret over it.

9. To see the theoretical normal distribution with the given average and standard deviation of the data (Fig. 5), turn on the THEORY button. This button should not be left on continuously as it will slow down the calculations considerably.

10. When this section of data is completed, turn on the STOP button and get light-pen button options:

DOCUMENT - a) A light-pen response from a point on the histogram will cause the displacement of the selected X and the probability of the selected bandwidth to be added into the documentation; b) a light-pen response from the word DOCUMENT will cause the typewriter to type out the following items:

the title

channel

number of data points =

mean =

probability of the mean =

sigma =

integral probability for 1 sigma =

integral probability for 2 sigma =

integral probability for 3 sigma =

granularity =
maximum X =
minimum X =

THIS FILE - a) A light-pen response rewinds the tape to the previous end of file mark; b) the options for continuing the calculations are the same as at the start of the program; c) the old tally registers are cleared.

NEXT FILE - a) A light-pen response advances the tape to the next end of file mark; b) the options for continuing the calculations are the same as at the start of the program; c) the old tally registers are cleared.

CONTINUE - a) A light-pen response continues calculations where they were stopped; b) no tally registers are cleared.

11. At any time that it would clarify the display, the MOVE TRACE RIGHT and MOVE TRACE LEFT buttons simply move the trace in the desired direction one increment at a time until the button is turned off.

12. For purposes of photography, the trace and limits can be removed from the display by means of the TURN TRACE OFF button. Turning the button off will return the trace and limits. The removal is only on the displays, thus calculations can proceed in either case.

VI. Input Tape Format

The input tape is a magnetic tape written at 800 bits per inch. The first record of each file should be a title record, identifying the following data, of up to and not exceeding 150 BCD characters. The second record through to the end of file are binary data records. There is one record per trace in each channel so that if, for example, there are three channels, there will be a record for the trace in the first channel, then a record for the trace in the second channel, and finally a record for the trace in the third channel.

The format for each record is as follows:

Word #1 - the first time word giving the number of the time block and the channel number of this trace in bits 7-8.

Word #2 - the second time word giving the number of the trace within the time block.

Word #3 - number of points along the trace = K.

Word #4 - the first Y value of the trace (not used).

Word #5 - the X value of the baseline (not used).

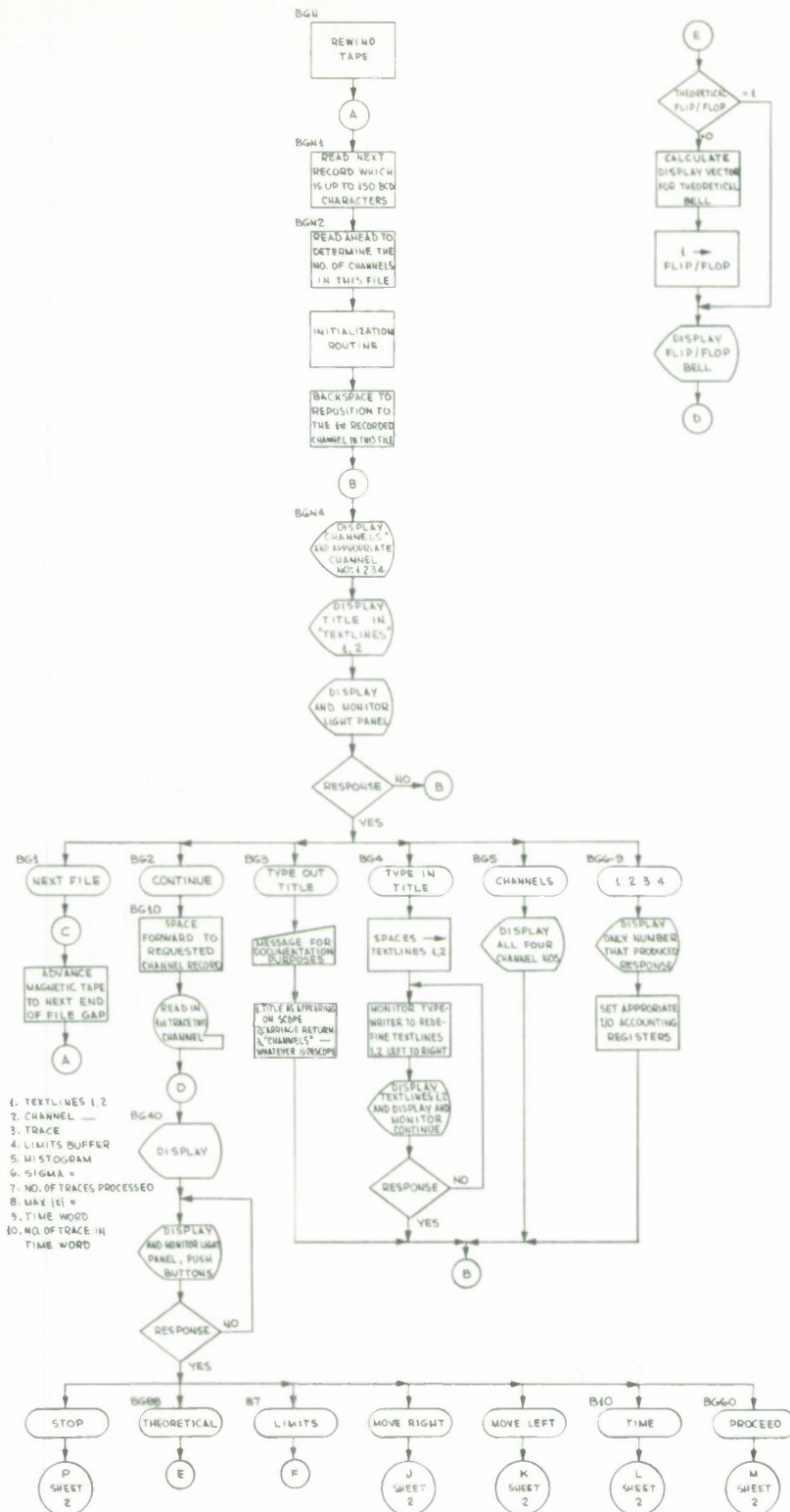
Word #6 - the leading edge of the trace (not used).

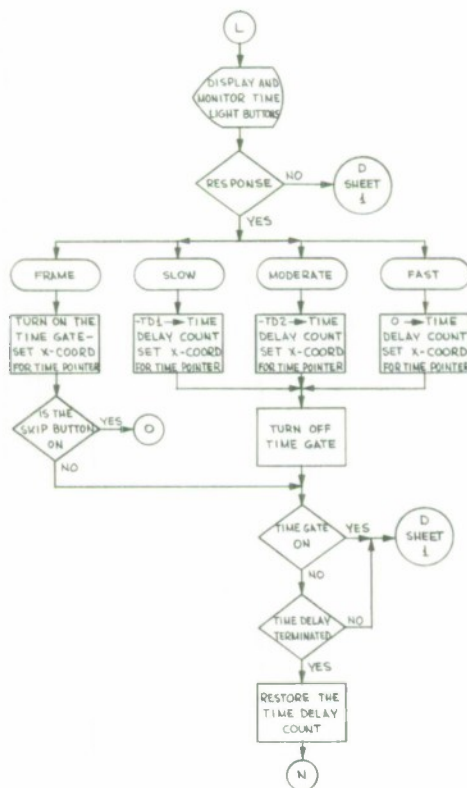
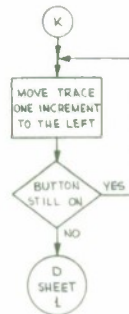
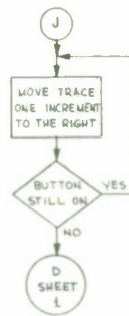
Word #7 to 7+K-1 - the X values of the trace with the baseline removed.

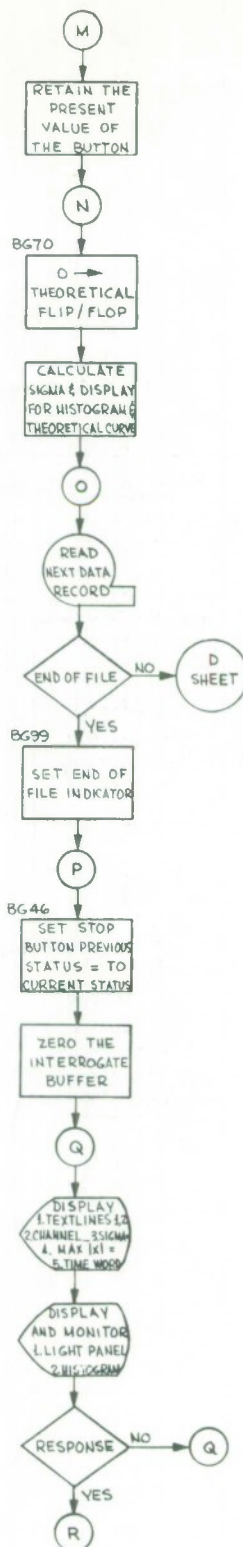
These values have been multiplied by 2^8 so in this program they are divided by 2^8 , i. e., right justified, before all calculations.

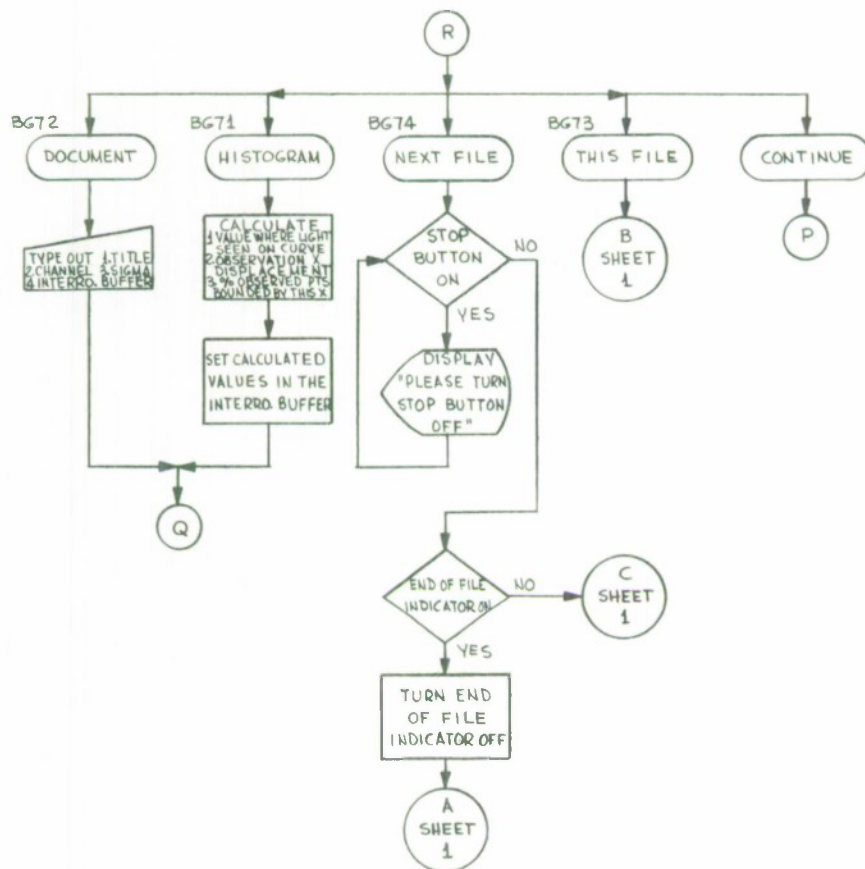
APPENDIX:

Flow Charts and Program Listing










```

/BASELINE STUDY PROGRAM

/CONSTANTS

100 004033      JMP BGN
    777777
    777777
104 777777
    777777
    777777
    777777
    777777
110 001000
    000100
    777777
    777777
    777777
114 777777
    777777
    777777
116 777777
    777777
    777777
    730003
124 075000
    720025
    720125
    720227
    720225
    720026
    720126
    721427
    720127
    000005
    001000
    040500
    050100

FLIPFLOP,      .-.
REOFFN,        .-.
TIME,          .-.
THEORY,        .-.
EOFNO,         .-.
PROCF0,        .-.
T01,           1000
T02,           100
TOC,           .-.
NUMCHN,        .-.
CHNSEL,        .-.
TIMGAT,        .-.
STYLE,         .-.

NCP,           .-.
MU,            REPEAT 2,0
SIGMA,         .-.
XYNOH,         .-.
IO,            TYO
GRANULE,
OLA=720025
CRS=720125
CSS=720227
OCF=720225
ORA=720026
ORC=720126
OSE=721427
OSP=720127
TAPE=5
DNSTY=000
SZM=SZM-SMA
SNA=SZM I
TOTAL,         REPEAT 2, 0
SXS,           REPEAT 4, 0
SX,            REPEAT 2, 0

.-.            /1=0ISPLAY, 0=CALCULATE
.-.            /REDEFINE BUTTON STATUS
.-.            /TIME BUTTON STATUS
.-.            /THEORETICAL BUTTON STATUS
.-.            /E.O.F. REACHED
.-.            /CONSOLE BUTTON STATUS
.-.            /SLOW COUNT FORTIME DELAY CLOCK
.-.            /MODERATE COUNT FOR T.D.C.
.-.            /TIME DELAY CLOCK
.-.            /NUMBER OF CHANNELS ON TAPE
.-.            /CHANNEL NUMBER SLECTED BY USER
.-.            /TIME GATE
.-.            /MODE OF OPERATION 0=FRAME, 1=SLOW
.-.            /2=MODERATE, 3= FAST
.-.            /NO CHANGE PROCESS SWITCH
.-.            /AVERAGE=1000.
.-.            /STO: OEV.=1000.
.-.            /X AND Y COORDINATES LAST SEEN
.-.            /OUTPUT INSTRUCTION
SAR 0          /GRANULATION OF X AXIS ON HYSTOGRAM

/SYSTEM MACROS

DEFINE STZ A,B,C,O,E,F,G,H,I
IRP Z,,A,B,C,O,E,F,G,H,I:
OZM Z
ENDIRP

TERMINATE

DEFINE SET A,B
LAW 0
OAC A

TERMINATE

```

```

DEFINE      SETUP A,B
            LAC B
            DAC A
TERMINATE
DEFINE      ISET A,B
            LAW I B
            DAC A
TERMINATE
DEFINE      IF A,B,C,D
            LAC A
            ADD (0
            SZA I
            JMP C
            SPA
            JMP B
            JMP D
TERMINATE
DEFINE      ENDDFMODULE /ZZ
            VARIABLES
            CDNSTANTS
ZZ,         HLT
            WORD JMP ZZ
TERMINATE
DEFINE      TRACKS
            JSP I (LPFOLL+10000
            LID I (YPT+10000
            RIL 9S
            LAC I (XPT+10000
            RCL 9S
            DAC XYNOW
TERMINATE
DEFINE      PUNCH
            CLF 6
            LAT
            RAL 7S
            SPA
            STF 6
            LAC (TYD-I
            STF 6
            LAC (PPA-I
            DAC ID
TERMINATE
DEFINE      RETRACK
            DZM I (WRXL +10000
            DZM I (WRYB+10000
            IRP B,,RPX,WPX,RPY,WPY,
            SET I (B+10000,500
            ENDIRP
            SET I (WRXR+10000,1777
            SET I (WRYT+10000,1777
TERMINATE

```

```

/REPLAY A,B,C,D,
/A=1 MEANS CONTINUE DISPLAYING WHAT IS NOW ON.
/A=0 MEANS STOP
/B=1 MEANS ENABLE THE LIGHT PEN
/B=0 MEANS DISABLE THE LIGHT PEN
/B=2 MEANS LEAVE LIGHT PEN STATUS ALONE
/C=EXTENDED ADDRESS OF NEW THING TO DISPLAY
/D=EXTENDED ADDRESS OF THING TO NOT DISPLAY

DEFINE REPLAY A,B,C,0/ZZ

G=.

TEXT / C /
TEXT / D /

ZZ,

ZZ=ZZ-G

G/ /RESET THE LOCATION COUNTER

H=0 REPEAT 0IF VZ A+B, REPEAT 1IF VZ A+2*B-5, H=1
L=1
REPEAT 1IF VP ZZ-3, L=0
REPEAT 1IE VZ ZZ-3, L=0 /INSURE THIS CASE
REPEAT 1IF VZ L*B-1, JSP 1 (RPIOA STOP
/THE ABOVE IS THE SHORT CALL TO REPLAY
/AND IT OCCURS ONLY FOR A REPLAY 1,2

DIO X*CD
LAC (C*0
LIO (D*0
JCA REPAX
REPEAT 1IE VZ A+B, 0
REPEAT 0IF VZ A+B, A+2*B
LIO XCD

*
TERMINATE

DEFINE NEXTCRT A
LAC 1A
JOA PNXT

TERMINATE

PNXT, *-
DAC PNXT*TX
IRP B,,CRTCON,CRTNF,CRTTO,CRTTI,CRTTF,CRTDDC
B,,
REPLAY 1,2,B
ENDIRP
CRTCON, REPLAY 1,2,0,CRTCON
CRTNF, REPLAY 1,2,0,CRTNF
CRTTO, REPLAY 1,2,0,CRTTO
CRTTI, REPLAY 1,2,0,CRTTI
CRTTF, REPLAY 1,2,0,CRTTF
CRTDDC, REPLAY 1,2,0,CRTDDC

```

139 777777
247111

203	200135			LAC PNXC'T
204	600207		JMP .+3	
			REPLAY 1,2,CRTCON	
213	617111		JMP 1 PNXC'TX	
214	240321	RP10A,	OAC REPXX	
	827112		DIO *XCD	
	600274		JMP RP10	
217	777777	REPAX,	--	/ADDRESS OF NEW THING TO DISPLAY
220	240321		OAC REPXX	/SAVE RETURN ADDRESS
	527113		DIO *REP1	/SAVE ADDRESS OF THING TO NOT DISPLAY
	230321		LID 1 REPXX	/GET INSTRUCTIONS
	440321		ICX REPXX	/FORM PROPER EXIT ADDRESS
224	673001		RCR 15	/GET DISPLAY COMMAND
	640400		SMA	/CONTINUE DISPLAYING
	600336		JMP REP7	/NO, GO ERASE BUFFER
	673003	REP2,	RCR 25	/YES, SO GET NEXT COMMAND
230	650400		SMA 1	/SHOULD THE LIGHT PEN BE CHANGED
	600236		JMP REP4	/NO
	027170		AND 120000	/MASK OUT ALL BUT PEN COMMAND
	047171		IOR 140000	
234	671037		RAR 55	/ALIGN WITH 340 COMMAND
	240434		OAC PNSTS	/PUT IN PEN STATUS REGISTER
	200217	REP4,	LAC REPAX	/NO, SO IS THERE ONE NEW ENTITY
	640100		SZA	
240	600435		JMP RP12	/YES, SO PUT ON LIST
	640100		SZA	/BUT FIRST BE SURE IT IS NOT DUPLICATED
	440432	RP11,	IDX RPNT	/AND UPDATE POINTER
	207113		LAC *REP1	/IS THERE ONE ENTITY TO DELETE
244	650100		SZA 1	
	600274		JMP RP10	/NO
	700350		LAW BPLY	/GET DISPLAY BUFFER ADDRESS
	247114		OAC *NPNT	/SET A POINTER
250	217114	RP9,	LAC 1 NPNT	/GET A DISPLAY ENTITY
	607113		SAD REP1	/IS IT THE ONE TO BE DELETED
	600257		JMP RP8	/YES
	650100		SZA 1	/NO, BUT ARE WE AT END OF TABLE
254	600274		JMP RP10	/YES, SO ALREADY DELETED
	447114		ICX NPNT	/UPDATE POINTER
	600250		JMP RP9	/AND GO BACK FOR NEXT ENTITY
	207114	RP8,	LAC NPNT	/GET PRESENT POINTER
260	247113		OAC REP1	/AND SAVE SO WE CAN MOVE
	447114		IDX NPNT	/TABLE DOWN ONE ENTRY
	217114		LAC 1 NPNT	/GET I+1 ENTRY
	257113		OAC 1 REP1	/PUT IN I TH ENTRY
264	650100		SZA 1	/AT END OF TABLE YET
	600271		JMP RP100	/YES
	447114		IDX NPNT	/NO
	447113		ICX REP1	
270	600262		JMP RP8+3	/GO BACK FOR REST OF TABLE
	710001	RP100,	LAW 1 1	
	400432		ADD RPNT	

273	240432		DAC RPNT	/MOVE BACK ENTRY POINTER
274	721427	RPT0,	DSE	/HAS PREVIOUS DISPLAY STOPPED
	600300		JMP .+3	
	720225		DCF	
	600302		JMP .+3	
300	720227		DSS	
	600331		JMP REP8K	/NO, SD CHECK IF TOO LONG
	710764	REP5,	LAW I 500.	
	247115		DAC REP9*9K	/RESET ERROR COUNTER
320	210433		LAC I NPNT	
	650100		SZA I	/HAS TABLE BEEN EXHAUSTED
	600322		JMP REP6	/YES, SO GO RESET
	240217		DAC REPAX	
310	210217		LAC I REPAX	
	027172		AND (-14002	
	040434		IOR PENSTS	
	250217		DAC I REPAX	
314	220217		LIO REPAX	
	440433		IDX NPNT	/UPDATE TABLE POINTER
	720025		DLA	/LOAD DISPLAY ADDRESS AND START
	227112		LIO XCD	
320	610321		JMP I .+1	
	600321	REPXX,	JMP .	/RETURN
	700350	REP6,	LAW BPLY	/INITIAL ADDRESS OF DISPLAY BUFFER
	240433		DAC NPNT	/RESET POINTER
324	100304		XCT REP5+2	/IS THERE ANYTHING TO DISPLAY
	640100		SZA	
	600307		JMP REP5+5	/YES
	227112		LID XCC	
330	610321		JMP I REPXX	/NO, SD RETURN
	227112	REP8K,	LIO XCD	
	467115		ISP REP9*9K	
	610321		JMP I REPXX	/NORMAL RETURN
334	720225		DCE	
	600302		JMP REP5	/DISPLAY HAS STOPPED TOO LONG, SD ERROR
	700350	REP7,	LAW BPLY	
	260340		DAP .+1	
340	340200		OZM .-.	
	440340		IDX .-1	
	527173		SAS (DZM BPLY+49.	
	600340		JMP .-3	
344	700350		LAW BPLY	/GET DISPLAY BUFFER ADDRESS
	240433		DAC NPNT	/RESET PICKUP POINTER
	240432		DAC RPNT	/RESET END OF LIST POINTER
	600227		JMP REP2	/CONTINUE
		BPLY,	REPEAT 50., 0	/DISPLAY BUFFER CONTAINS ADDRESSES OF SCOPE BUFFERS
432	000350	RPNT,	BPLY	/ADDRESS OF DISPLAY ENTITIES
	000350	NPNT,	BPLY	/POINTER TO NEXT OPEN REGISTER
434	000000	PENSTS,	0	/POINTER TO NEXT ITEM TO DISPLAY
	700350		0	/PEN STATUS (ENABLE OR DISABLE)
	247114	RP12,	LAW BPLY	/INITIALIZE POINTER
	217114		DAC NPNT	/TO START OF TABLE
440	500217		LAC I NPNT	/GET NEXT ENTITY
			SAC REPAX	/COMPARE TO NEW ENTITY

```

443 600243      JMP RP11+1      /ENTITY IS ALREADY BEING DISPLAYED
450100      SZA I          /ARE WE AT END OF TABLE
600446      JMP L+3        /YES
444 447114      IDX NPNT     /GO LOOK AT NEXT ENTITY
600437      JMP RP12+2     /CONTINUE
200217      LAC REPAX      /NEW ENTITY
250432      DAC I RPNT     /SO ENTER IT INTO TABLE
450 600242      JMP RP11     /RETURN TO INDEX POINTER

```

/TAPE ROUTINES AND MACROS

/NOTE THAT 2=EVEN PARITY

```

/ 1=ODD PARITY
/ 800 OCTAL MEANS 800 RPI
/ 556 OCTAL MEANS 556 RPI
/ 200 OCTAL MEANS 200 RPI

```

```

DEFINE REWIND UNIT
LAW UNIT          /TAPE UNIT NUMBER
DAC I IQCOUNT+10000
JSP I IQCQREW+10000

```

TERMINATE

```

DEFINE TAPWRT DENSITY,UNIT,PARITY,FIRST,LAST,ENDPOINT
REPEAT 11F VZ DENSITY-800,      LAW 2
REPEAT 11F VZ DENSITY-200,      CLA
REPEAT 11F VZ DENSITY-556,      LAW 1
DAC I IQCQDEN+10000             /DENSITY (800,556,OR 200)
LAW UNIT          /UNIT NUMBER (0-7)
OAC I IQCQUNT+10000
LAW PARITY        /PARITY (EVEN OR ODD)
SUB I 1
OAC I IQCQPAR+10000
JSP T IQCQWR+10000
FIRST             /ADDRESS OF START OF BLOCK
LAST+1            /ADDRESS OF END OF BLOCK
JSP BACTAP        /BAD TAPE RETURN
ENDPOINT          /END OF TAPE RETURN

```

TERMINATE

```

DEFINE TAPRD DENSITY,UNIT,PARITY,FIRST,LAST,EDF
REPEAT 11F VZ DENSITY-800,      LAW 2
REPEAT 11F VZ DENSITY-200,      CLA
REPEAT 11F VZ DENSITY-556,      LAW 1
DAC I IQCQDEN+10000             /TAPE DENSITY
LAW UNIT
DAC I IQCQUNT+10000             /TAPE UNIT NUMBER (0-7)
LAW PARITY
SUB I 1                      /PARITY (ODD OR EVEN)
OAC I IQCQPAR+10000
JSP T IQCQRD+10000             /GO READ THE TAPE
FIRST             /STARTING ADDRESS OF BLOCK
LAST+1            /END ADDRESS OF BUFFER
JSP BACTAP        /BAD TAPE RETURN
EOF               /END OF FILE RETURN

```

TERMINATE


```

DEFINE TAPSPC DENSITY,UNIT,PARITY,NUM,EOF
REPEAT IIF VZ DENSITY=800,      LAW 2
REPEAT IIF VZ DENSITY=200,      LAW 0
REPEAT IIF VZ DENSITY=556,      LAW 1
OAC I (QQCDEN+10000)            /TAPE DENSITY
LAW UNIT
OAC I (QQCUNT+10000)            /TAPE UNIT NUMBER (0-7)
LAW PARITY
SUB I 1                          /TAPE PARITY
OAC I (QQCPAR+10000)
JSP I (QQQSP+10000)            /GO SPACE THE RECORDS
NUM                             /NUMBER OF RECORDS TO SPACE
JSP BADTAP                      /BAD TAPE RETURN
EOF                             /END OF FILE RETURN

```

TERMINATE

```

/ROUTINE FOR TYPING OUT CHARACTERS
/JDA TYPE WITH EXTENDED ADDRESS IN AC AND
/NUMBER OF CHARACTERS TO TYPE IN ID

```

451	777777	TYPE,	-.,	/EXTENDED ADDRESS
	200507		OAP T1	/PROGRAM COUNTER
	320511		OIO NUMBER	/NUMBER OF CHARACTERS
454	340510		DZM COUNTX	/NUMBER OF TYPED CHARACTERS
	710003		LAW I 3	
	240512		OAC M3	/SINCE 3 CHARACTERS PER WORD
	724074		EFM	
460	230451	T3,	LIO I TYPE	
	062077	T2,	RIL 6S	
	827116		DID 831M2	
	170550		JOA 9PT	
464	227116		LIO 831M2	
			PUNCH	
476	340510		IDX COUNTX	
	500511		SAD NUMBER	/TEST IF HAVE FINISHED TYPING
500	000507		JMP T1	/YES - LEAVE
	060512		ISP M3	/NO - TEST IF HAVE FINISHED WORD
	000461		JMP T2	/NO - CONTINUE
	040451		IDX TYPE	/YES - GO ON TO NEXT WORD
504	710003		LAW I 3	/YES - REPLACE MINUS 3
	240512		OAC M3	
	000460		JMP T3	
	000507	T1,	JMP ..	/LEAVE
510	777777	COUNTX,	-.,	
	777777	NUMBER,	-.,	
	777777	M3,	-.,	
	000000	CPT,	0	/DECIMAL POINT ROUTINE
514	247117		OAC OP'XXX	
	340547		OZM OPI	
	227176		LID (C-CHARACTER R-	
	200513	CP4,	LAC OPT	
520	040200		SPA	
	170550	DPO,	JCA 9PT	
		,		

S22 640200
 761020
 S24 240513
 240530
 647177
 567200
 S30 000000
 520547
 600525
 663777
 S34 663777
 450100
 200523
 663777
 S40 663777
 100521
 200530
 500513
 S44 617117
 240547
 600517
 000000
 S50 000000
 260601
 710770
 673077
 S54 227201
 673777
 260557
 672000
 S60 642000
 020552
 663777
 663077
 S64 100123
 S73 720033
 S74 663777
 027202
 627202
 600565
 600 200550
 600000

SPA
 CMA CHARACTER R0
 DP0, DAC DPT
 DP3, DAC DP2
 MUL 11
 DIV 110.
 DP2, 0
 SAS DP1
 JMP DP3
 RCL 9S
 RCL 9S
 SZA I
 LAC DP0
 RCL 9S
 RCL 9S
 XCT DP0
 LAC DP2
 SMO DPT
 DPX, JMP I DPXX
 DAC DP1
 JMP DP4
 DP1, 0
 9PT, 0
 DAP 9PX
 LAW I 770
 RCR 6S
 LID 1252002
 RCR 9S
 OAP .+1
 RIR
 SPI
 AND 9PT+2
 RCL 9S
 RCL 6S
 XCT ID
 ZZGF, REPLAY 1,0 /DISABLE THE DISPLAY
 CKS
 RCL 9S
 AND 1120
 SAS 1120
 JMP ZZGF /KEEP DISPLAY GOING
 LAC 9PT
 9PX, JMP

/SUBROUTINE TO RESPOND TO AN INPUT
 /ENTRY BY A JDA RESPOND WITH 0 IN AC IF LIGHTPEN, 1 IF BUTTONS
 /ROUTINE EXITS N LOCATIONS AFTER THE JSP AS FOLLOWS
 / 0= NO RESPONSE
 / 1= LIGHT PEN /NEXT FILE
 / 2= LIGHT PEN /CONTINUE
 / 3= LIGHT PEN /TYPE OUT TITLE
 / 4= LIGHT PEN /TYPE IN TITLE

```

/ 5= LIGHT PEN           /CHANNEL
/ 6-7-8-9= LIGHT PEN    /CHANNEL NO. (1,2,3,4)
/ 10= LIGHT PEN          /FRAME
/ 11= LIGHT PEN          /SLOW
/ 12= LIGHT PEN          /MODERATE
/ 13= LIGHT PEN          /FAST
/ 14= LIGHT PEN          /THIS FILE
/ 15= LIGHT PEN          /CURVE
/ 16= LIGHT PEN          /DOCUMENT
/ 17= LIGHT PEN          /HISTOGRAM
/ 18= LIGHT PEN          /A NAME
/ 19= LIGHT PEN          /TRACE
/ 20= LIGHT PEN          /A LIMIT
/ 1 CONSOLE BUTTON      /REDEFINE
/ 2 CONSOLE BUTTON      /DELETE
/ 3 CONSOLE BUTTON      /NAME
/ 4 CONSOLE BUTTON      /UPPER
/ 5 CONSOLE BUTTON      /LOWER
/ 6 CONSOLE BUTTON      /STOP
/ 7 CONSOLE BUTTON      /THEORETICAL
/ 8 CONSOLE BUTTON      /LIMITS
/ 9 CONSOLE BUTTON      /TIME
/ 10 CONSOLE BUTTON     /PROCEDURE
DEFINE RESPOND WHICH,NONE,A1,A2,A3,A4,A5,A6,A7,A8,A9,A10,A11,A12,A13,A14,A15,
ZZ, LAW WHICH           /0=LIGHT PEN, 1=BUTTON
DEFINE PASS A
REPEAT IIF P, REPEAT IIF VZ A+0, JMP A
/LEGAL RESPONSE, SO EXIT ACCORDINGLY.
REPEAT IIF P, REPEAT IIF VZ A+0, JMP Z7+2
/ILLEGAL RETURNS ARE TREATED AS 'NO RESPONSES'.
REPEAT IIF P, 0
/ZERO INSERTED ON PASS 1 TO KEEP LOCATION COUNTER HAPPY
TERMINATE PASS
IRP B,,NONE,A1,A2,A3,A4,A5,A6,A7,A8,A9,A10,A11,A12,A13,A14,A15,A16,A17
PASS B
ENDIRP
EQUALS PASS,NULL
TERMINATE

PRID, .-.
OAC *PRIX
LAC PRID
SPA
CMA
OAC *PRAA
LAC PRAA
SUB (10.
SPA
JMP PRID
SUB (90.
SPA
JMP PRID
SUB (900.

```

```

602 377777
      247120
604 200002
      440200
      741000
      247121
610 207121
      027200
      440200
      400635
614 027203
      440200
      400645
      427204

```


620	440200	SPA		
	600647	JMP PRI000		
	200602	LAC PRI0		
	647177	MUL 11		
624	967205	OIV 11000.		
	740000	NOP		
	827123	DIO *PRIS		
	170513	JCA DPT		
630	207122	LAC PRIS		
	640200	SPA		
	741000	CMA		
	240602	DAC PRI0		
636	400604	JMP PRI0+2		
	420651	JSP PRSG	PRI0,	
	227206	LIO 120		
	170550	JCA 9PT		
640	227206	LIO 120		
	170550	JCA 9PT		
	207121	LAC PRAA		
	170513	JCA DPT		
644	417120	JMP 1 PR1X		
	620651	JSP PRSG	PRI00,	
	400640	JMP PRI0+3		
	620651	JSP PRSG	PRI000,	
	400642	JMP PRI0+5		
650				
651	260661	DAP .+0.	PRSG,	
	200602	LAC PRI0		
	440400	SMA		
654	400657	JMP .+3		
	227176	LIO 1 CHARACTER R-		
	170550	JCA 9PT		
	227207	LIO 1 CHARACTER R.		
660	170550	JCA 9PT		
	400000	JMP .-.		
662	777777		TESPOND,	
	241173	DAP RESPOX		.-. /0= LIGHT PEN, 1= BUTTON
664	200662	LAC TESPOND		/SAVE RETURN ADDRESS
	440100	SZA		/GET CODE FOR WHAT TO CHECK
	401174	JMP BUTTO		/LIGHT PEN OR BUTTONS
	720127	DSP	CANE,	/BUTTONS
	401173	JMP RESPOX		/LIGHT PEN BREAKS
670	720126	ORC		/NOT A LIGHT PEN INTERRUPT
	820122	OIO XYNOW		/SAVE COORDINATES
	720026	ORA		/OF POINT JUST SEEN.
674	720225	OCF		/GET ADDRESS
	720125	ORS		/CLEAR ALL THE FLAGS
	443777	RCL 95		/AND NOW RESUME THE DISPLAY.
	443777	RCL 95		
700	427177	SUB 11		
	247123	DAC R'ESPP		/SAVE THE TABLE ADDRESS

```

DEFINE      TESTN A,B,C
            LAC RESPP
            SUB IA
            SMA I
            JMP .+7
            ADD IA
            SUB IB
            SZM
            JMP .+3
            LID IC
            JMP GONOW

TERMINATE

            TESTN DATA,DATA+2000.,17.
            TESTN CHANNELS,CHANNELS+5,5
            TESTN CHANNELS 5,CHANNELS 6,6
            TESTN CHANNELS 6,CHANNELS 7,7
            TESTN CHANNELS 7,CHANNELS 8,8.
            TESTN CHANNELS 8.,CONTINUE,9.
            TESTN CONTINUE, NEXTFILE,2
            TESTN NEXTFILE,TYPDUT,1
            TESTN TYPDUT,TYPIN,3
            TESTN TYPIN,THISFILE,4
            TESTN THISFILE,DOCUMENT,14.
            TESTN DOCUMENT,FRAME,16.
            TESTN FRAME, SLOW,10.
            TESTN SLOW,MODERATE,11.
            TESTN MODERATE,FAST,12.

            TESTN FAST,INFO,13.
            TESTN TRACE,THYBL,19.
            TESTN LIMITS,LIMITS+8*19.,20.
            CLI
GONOW,      RCL 9S          /GET EXIT CODE
            RCL 9S
            ADD RESPOX      /INDEX EXIT ADDRESS
            DAC RESPOX      /FORM RETURN ADDRESS
RESPDX,     JMP .          /RETURN
BUTTD,      LAT
            RCL 9S
            RCL 9S
            CLA
DEFINE      TEST A
            RIR IS
            SPI
            LAW A
            JMP GGNDW

TERMINATE   TEST 1          /T.W. 17 = REDEFINE
            TEST 2          /T.W. 16 = DELETE
            TEST 3          /T.W. 15 = NAME
            TEST 4          /T.W. 14 = UPPER
            TEST 5          /T.W. 13 = LOWER

```

```

1166  764000
      463777
1170  463777
      401173
      241173
      401173
1174  762200
      463777
      463777
      760200

```

		TEST 6	/T.W. 12 = STOP
		TEST 7	/T.W. 11 = THEORETICAL
		TEST 8.	/T.W. 10 = LIMITS
		TEST 9.	/T.W. 9 = TIME
		TEST 10.	/T.W. 8 = PROCEED
			/T.W. 7=OUTPUT OPTION
			/T.W. 6 = SKIP FRAME
			/NO RESPONSE
1250	611173	JMP I RESPON	
		EQUALS TEST, NULL	
1251	401173	AD0 RESPON	/A BUTTON WAS DOWN
	241173	OAC RESPON	/SO FORM RETURN ADDRESS
	611173	JMP I RESPON	/AND EXIT
		START	

GGNOW,


```

BASELINE 2

DEFINE      DPR SUBR
            OAC I (SURR
            JSP I (SURR+1

TERMINATE

/JSP 'CALCUL'

1254  262520
      201562
      650100
      602150
1260  761000
      241735

CALCUL,    OAP RETURN      /PROGRAM COUNTER
            LAC N           /NO. SETS TO PROCESS IN TRACE
            SZA I           /TEST IF HAVE BEEN SET
            JMP THOR        /NO-GO TO THEORETICAL
            CMA             /YES-COMPLIMENT
            OAC NN          /FOR INDEXING LATER

NSEC,      REPLAY I,2      /KEEP DISPLAY GOING

1268  207256
1264  431563
      547177
      567124
      760000
1270  401532
      241533

            LAC (SCOTSC     /FIRST Y VALUE ON SCOPE
            SUB I Y          /HIGH Y LIMIT
            MUL (I
            DIV B*CBY
            NOP
            ADO W7           /ADDRESS OF 1ST X VALUE
            OAC COUNTER      /BEGINNING OF DESIRED X VALUES

            REPLAY I,2      /KEEP DISPLAY GOING

1273  211563
1274  431564
      547177
      567124
      760000
1300  407177
      761000
      241734
      761000
1304  651600
      400125
      027257
      240125
1310  641000
      440126

            LAC I Y
            SUB I Y+1        /NO. PTS. W/I LIMITS
            MUL (I
            DIV R0BY
            NOP
            ADO (I          /WANT INCLUSIVE SECTION
            CMA
            DAC NUM         /FOR INDEXING LATER
            CMA
            CLO
            ADD TOTAL        /TOTAL NO. OF X SUB I
            ANO (377777
            DAC TOTAL        /LOW ORDER REGISTER
            SZO
            ICX TOTAL+1      /HIGH ORDER REGISTER

1312  231533
      207260

LOOP,      LIO I COUNTER    /X SUB I VALUE
            LAC (SX         /ADDRESS OF SUM X SUB I
            DPR DAD         /DOUBLE PRECISION ADD
            LAC I COUNTER
            MUL I COUNTER    /X SUB I SQUARED
            RIR 1S          /EIX SIGN BIT
            DIO TEMP1        /LOW ORDER
            OAC TEMP1+1      /HIGH ORDER
            DZM TEMP1+2
            DZM TEMP1+3

1316  211533
      051533
      672001
1320  021535
      241536
      541537
1324  841540

```

1325	341541		OZM TEMP2	
	341542		OZM TEMP2+1	
	341543		OZM TEMP2+2	
1330	341544		OZM TEMP2+3	
	207263		LAC (SX5	/ADDRESS OF CUMULATIVE X SQ.
	227264		LID (TEMP1	/ADDRESS OF SQUARED VALUE
			DPR DDAD	/4 REGISTER PRECISION ADD
			REPLAY 1,2	/KEEP DISPLAY GOING
1336	211533	LDDP1,	LAC I COUNTER	
	450200		SPA I	
1340	401344		JMP .+4	
	407177		ADD (I	
	450100		SZA (
	401346		JMP .+3	
1344	100124		XCT GRANULE	/SHIFT INSTRUCTION TO THE RIGHT
	440200		SPA	
	427177		SUB (I	
	241535		DAC TEMP1	
1350	440200		SPA	
	701000		CMA	
	427267		SUB 1457.	/MAXIMUM POSSIBLE FOR
	440500		SZM	/SCOPE DISPLAY
1354	417270		JMP I (RESET+10000	
1355	201535		LAC TEMP1	/CORRECT X VALUE
	465001		SAL IS	/SINCE DOUBLE PRECISION
	407271		ADD (ZLOC	
			DPR DINDEX	/TO GET DOUBLE PRECISION INDEX
1362	441533		IDX COUNTER	/TO NEXT X SUR (
	401734		ISP NUM	/TEST IF HAVE FINISHED
1364	601312		JMP LDCP	/NO-CONTINUE
	401735		REPEAT 2,	IDX Y IDX Y+1
	401262		ISP NN	/TEST IF HAVE FINISHED TRACE
			JMP NSEC	/NO-DO NEXT SECTION
			REPLAY 1,2	/KEEP DISPLAY GOING
1374	207274		LAC (YXYXL	
	241563		DAC Y	
	207275		LAC (YXYXL+1	
	241564		DAC Y+1	
1400	200133		LAC SX	/LOW ORDER PART
	547205		MUL (1000.	/FOR ACCURACY
	472001		RIR IS	
	820117		DID MU	
1404	240120		DAC MU+1	
	200134		LAC SX+1	/HIGH ORDER PART
	547205		MUL (1000.	
	467777		SCL 95	
1410	467377		SCL 85	/CANNOT BE MORE THAN 1 REGISTER

1411	000120		ADD MU+1	
	240120		DAC MU+1	/HAVE SX-1000. IN MU NOW
1413	207276		LAC (ML	
1414	227277		LID (TOTAL	
1417	240117		DPR DPCIV	
1420	320120		DAC MU	
	200125		CID MU+1	/AVERAGE TIMES 1000.
	427177		LAC TOTAL	
	241535		SUB (1	
1424	040200		DAC TEMP1	
	001522		SPA	
	200126		JMP BORROW	
	241536		LAC TOTAL+1	
1430	207260	TP,	DAC TEMP1+1	
	227260		LAC (SX	
			LID (SX	
1434	001541		DPR DMUL	/4 REGISTER PRODUCT
	207304		TEMP2	/ADDRESS OF PRODUCT
	227277		LAC (TEMP2	/ADDRESS OF LOW ORDER PART
			LID (TOTAL	/ADDRESS OF LOW ORDER PART
1441	001541		DPR DPCIV4	
	701541		TEMP2	
	201445		LAW TEMP2	
1444	201447		DAP .+2	
	200000		DAP .+3	
	161000		LAC .-	
	240000		CMA	
1450	441447		DAC .-	
	441445		IDX .-1	
	927307		IDX .-4	
	001445		SAS (LAC TEMP2+4	
1454	227263		JMP .-6	
	207304		LID (SXS	
			LAC (TEMP2	/ADDRESS OF LOW ORDER PART 4 REG. NO.
			DPR DDAD	/4 PRECISION ADDITION
		A,,	IRP A,,0,1,2,3+	
			LAC TEMP2+A	
			DAC I (MAC 10000+4+A	
			ENDIRP	
1460	201541	0,	LAC TEMP2+0	
	257310		DAC I (MAC 10000+4+0	
	201542		1,	LAC TEMP2+1
	257311		DAC I (MAC 10000+4+1	
1464	201543		2,	LAC TEMP2+2
	257312		DAC I (MAC 10000+4+2	
	201544		3,	LAC TEMP2+3
	257313		DAC I (MAC 10000+4+3	
1470	110010		LAW I 10.	
	247135		DAC FLIPF	
	037314		JSP 1 (XSHIFT+10000	
	407135		ISP FLIPF	
1474	001472		JMP .-2	
		A,,	IRP A,,0,1,2,3+	
			LAC I (MAC+10000+4+A	
			DAC TEMP2+A	
			ENDIRP	
1475	217310	0,	LAC I (MAC+10000+4+0	
	241541		DAC TEMP2+0	
	217311		1,	LAC I (MAC+10000+4+1
1500	241542		DAC TEMP2+1	

217312
 241543
 217313
 1504 241544
 207304
 227264
 1513 200121

2,
 DAC TEMP2+2 LAC I (MAC+10000+4+2
 3 LAC I (MAC+10000+4+3
 DAC TEMP2+3 LAC (TEMP2
 LIO (TEMP1
 DPR DPDIVF+10000 /QUOTIENT IN AC
 DPR SORT /GET STANDARD DEVIATION FROM VARIANCE
 LAC SIGMA


```

1514 647321      MUL (31.
      867177      OIV (1
      760000      NOP
      240121      OAC SIGMA
1521 601742      REPLAY 1,2      /KEEP OISPLAY GOING
      JMP COMPUTE      /TO LOAD BUFFER FOR HISTOGRAM OISPLAY

1522 807171      BORROW, ACO (400000      /BORROW FORM HIGH ORDER
      241535      OAC TEMP1
1524 710001      LAW I 1
      800126      ACO TOTAL+1
      241536      OAC TEMP1+1
      001430      JMP TP

/TO CALL. JSP CALCUL
/ RETURN
/
/
/INITIALLY. SX SET TO ZERO ',REGISTER WITH SUR XI
/ SXS SET TO ZERO ',REGISTER WITH SUB (X12)
/ TOTAL SET TO ZERO ',TOTAL NUMBER OF PTS. IN SAMPLE
/
/
/INPUT. N NUMBER OF SETS OF LIMITS
/ YH1 HIGH Y LIMIT
/ YL1 LOW Y LIMIT
/ YH2
/ HL2
/ THROUGH
/ YHN
/ YLN
/
/
/OUTPUT. CUMMULATIVE STO. DEV. IN REGISTER 'SIGMA'
/ CUMMULATIVE FREQUENCY CURVE IN BUFFER
/ AREA 'TABLE' PLUS NEXT 18300 LOCATIONS
/ WITH BASELINE FREQUENCY AT LOCATION
/ 'ZLOC' WHICH IS IN MIDDLE OF TABLE.
/
/
/
/FORMULAS. SIGMA=SO. RT. ((SUM X SUB 1 SO.-(SUM X SUB 1' SUM X SUB 11/N)/(N-1150
/ SO.RT.(Y) ' (Y/AN - AN)/2

/LOCATIONS AND CONSTANTS

010000      MODULE=10200
1530 030002      W3, 30002
      030003      W4, 30003
      030006      W7, 30006
1534 777777      COUNTER,
      777777      TEMP, -.
      777777      TEMP1, -.
      777777      TEMP1+1, -.

```

```

1537 777777 TEMP1+2,      .-
1540 777777 TEMP1+3,      .-
      777777 TEMP2,      .-
      777777 TEMP2+1,     .-
      777777 TEMP2+2,     .-
      777777 TEMP2+3,     .-
1544 000207 SAVEY,      000207 /STARTING Y COORDINATE
      000066 SAVEX,      000066 /STARTING X COORDINATE
      031003 PTHISTD,     DATA+3 /BUFFER FOR DISPLAYING HISTOGRAM
1550 020325 PTRACE,      TRACE+3 /BUFFER FOR DISPLAYING TRACE
      021151 TTBL,       THYTBLL+3 /BUFFER FOR DISPLAYING THEORETICAL
      777777 SAVEXX,     .-
      777777 SAVEYY,     .-
1554 777777 DX,          .-
      777777 DY,          .-
      777777 DY+1,       .-
      777777 DDY,        .-
1560 777777 RRR,         .-
      777777 NNN,        .-
      000000 N,          0 /NUMBER OF LIMIT SETS
      001572 Y,          YXYXL
1564 001573 Y,          YXYXL+1
      001623 K915,       915.
      000000 K915+1,     0
      001274 K700,       700.
1570 000000 K700+1,     0
      777777 COUNT,      .-
      YXYXL REPEAT 20., 0 /TRACE LIMIT PAIRS

```

```

/COORD. SUBR, HISTO BUFFER, THEORY BUFFER, AND TRACE BUFFER SET
/TO COMPUTE INCREMENTS IN MINOR COORDINATE WITH WHOLE
/STEP INCREMENTS IN MAJOR COORDINATE AND FINAL STEP
/INCREMENTS FOR BOTH TO COMPLETE THE VECTOR
/'JSP COORD' WITH X DIFFERENCE IN 'MIN' AND Y DIFFERENCE
/IN 'MAJ'

```

```

1616 261704 COORD,      DAP RTN      /PROGRAM COUNTER
      341741      DZH SW
1620 201733      LAC MIN
      040200      SPA
      701000      CMA
      241736      DAC R          /ABSOLUTE VALUE OF DIFFERENCE
1625 201732      REPLAY 1,2
      040200      LAC MAJ
      701000      SPA
1630 421736      CMA
      040200      SUB R
      001705      SPA          /TEST WHICH IS LARGER
      JMP SWITCH      /X IS
1633 201732 COORD1,     LAC MAJ
1634 041717      MUL 11        /SET UP FOR DIVISION

```

1635	867322		OIV 1177	/WHOLE STEP
	760000		NCP	
	821736		OID R	/INCREMENT IN PARTIAL STEP FOR MAJ
1640	450100		SZA I	/TEST IF NEED WHOLE STEP
	601713		JMP STEPS	/NO-SET UP FOR ONLY PARTIAL
	440200		SPA	
	761000		CMA	
1644	241734		DAC NUM	/NUMBER OF WHOLE STEPS
	761000		CMA	
	241735		OAC NN	/FOR INDEXING
			REPLAY 1,2	
1650	201733	LAC MIN		
	841736		MUL R	
	861732		DIV MAJ	
	760000		NCP	
1654	241740		OAC RP	/INCREMENT IN PARTIAL STEP FOR MIN
	761000		CMA	
	401733		ADD MIN	
	841717		MUL I	
1660	501734		DIV NUM	
	760000		NCP	
	440400		SMA	
	601666		JMP .+3	
1664	761000		CMA	/TO GET MAGNITUDE
	847323		ICR (200	/PUT IN MINUS SIGN
	241737		DAC W	
	201740		LAC RP	
1670	440400		SMA	
	401674		JMP .+3	
	761000		CMA	/TO GET MAGNITUDE
	847323		ICR (200	/PUT IN MINUS SIGN
1674	241740		DAC RP	
	201736		LAC R	
	440400		SMA	
	401703		JMP .+4	
1700	761000		CMA	/TO GET MAGNITUDE
	847323		ICR (200	/PUT IN MINUS SIGN
	241736		DAC R	
			REPLAY 1,2	/KEEP DISPLAY GOING
1704	601704	RTN,	JMP ..	/BACK TO PROGRAM
1708	201732	SWITCH,	LAC MAJ	/SO HAVE LARGER DIFFERENCE
	221733		LID MIN	/IN VARIABLE CALLED MAJ
	241733		DAC MIN	/AND SMALLER INCREMENT IN
1710	821732		DIO MAJ	/VARIABLE CALLED MIN
	441741		IDX SW	/SO KNOW THAT HAVE SWITCHED
	601633		JMP COORDI	
1713	841735	STEPS,	DZM NN	/NO WHOLE STEPS
1714	841734		DZM NUM	
	201732		LAC MAJ	
	440400		SMA	

1712	601722	JMP	+3	
1720	741000	CMA		/TO GET MAGNITUDE
	647323	IDR	(200	/MINUS SIGN
	241736	DAC	R	
	201733	LAC	MIN	
1724	440400	SMA		
	401730	JMP	+3	
	741000	CMA		/TO GET MAGNITUDE
	947323	IDR	(200	/MINUS SIGN
1730	241740	DAC	RP	
	401704	JMP	RTN	/BACK TO PROGRAM
1732	777777	MAJ,	.-.	/LARGER INCREMENT
	777777	MIN,	.-.	/SMALLER INCREMENT
1734	777777	NUM,	.-.	/NUMBER OF WHOLE STEPS
	777777	NN,	.-.	/NUMBER OF WHOLE STEPS, FOR INDEXING
	777777	R,	.-.	/INCREMENT IN MAJ. DIR. IN PARTIAL STEP
	777777	M,	.-.	/INCREMENT IN MIN. DIR. IN WHOLE STEP
1740	777777	RP,	.-.	/INCREMENT IN MIN. DIR. IN PARTIAL STEP
	000000	SW,	0	/0 IF Y=MAJ, X=MIN OR 1 IF Y=MIN, X=MAJ
		/LOADS BUFFER FOR HISTOGRAM INTO MODULE 3		
1742	457324	COMPUTE,		JSP I (TABTEST) /FIND RANGE OF BUFFER
	201534	LAC	TEMP	
1744	445001	SAL	15	
	407177	ADD	(1	
	741000	CMA		
	241533	DAC	COUNTER	/NO. OF STEPS
1750	461000	CMA		
	647205	MUL	(1000.	/FOR ACCURACY
	667325	OIV	(915.	/NO. HORIZONTAL INCREMENTS ON SLOPE
	760000	NDP		
1754	241554	DAC	DX	/FACTOR FOR X
	207326	LAC	(DATA+3	
	241547	DAC	PTHISTD	
		REPLAY	1,2	/KEEP DISPLAY GOING
1760	217327	LAC	I (MAXIMUM	/LOW ORDER BITS OF Y(MAX)
	147205	MUL	(1000.	
	672001	RIR	15	/SET SIGN BIT
	021535	DIO	TEMP1	
1764	241536	DAC	TEMP1+1	
	217330	LAC	I (MAXIMUM+1	/HIGH ORDER BITS OF Y(MAX)
	147205	MUL	(1000.	
	467777	SCL	95	
1770	467377	SCL	85	
	401636	ADD	TEMP1+1	
	241536	DAC	TEMP1+1	
	207264	LAC	(TEMP1	
1774	227331	LIO	(K700	/POSSIBLE INCREMENTS IN Y
		OPR	OPOIV	
1778	241555	OAC	OY	/DOUBLE PRECISION

2000	021556	DID DY+1	/FACTDR EDR Y
		REPLAY 1,2	/KEEP DISPLAY GDING
2002	207205	LAC (I000.	
	047177	MUL (1	
2004	061554	DIV DX	
	760000	NDP	
	047177	MUL (1	/SINCE INCREMENT IN
	067322	DIV (177	/X WILL ALWAYS BE THE SAME
2010	760000	NDP	
	021560	DID RRR	/CONSTANT DIFERENCE IN X DIRECTION
	040100	SZA	
	761000	CMA	
2014	241561	DAC NNN	
	041553	DZM SAVEYY	
		LDDP2, REPLAY 1,2	
2017	201534	LAC TEMP	
2020	005001	SAL 15	/SINCE DOUBLE PRECISION
	761000	CMA	
	007271	ADD (ZLDC	
	227332	LID (KI000	
		DPR DMUL	
2026	001535	TEMP1	
	201536	LAC TEMP1+1	/TEST IE NEED TO DD DOUBLE PRECISION
2030	040100	SZA	/DIVIDE - IE NOT, DISPLAY WILL BE
	002037	JMP .+6	/COMPLETED MUCH FASTER
	201535	LAC TEMP1	
	047177	MUL (1	
2034	061555	DIV DY	
	002037	JMP .+2	
	002043	JMP .+5	
	207264	LAC (TEMP1	
2040	227333	LID (DY	/ADDRESS DE HIGH MANTISSA
		DPR DPDIV	
2043	021553	SUB SAVEYY	/INTERESTED IN DIFERENCE
2044	241535	DAC TEMP1	/Y DIFERENCE
	041553	ADD SAVEYY	
	241553	DAC SAVEYY	/SAVE EDR NEXT DIFERENCE
	201535	LAC TEMP1	
2050	047177	MUL (1	/SET UP EDR DIVISION
	067322	DIV (177	/HOW MANY WHOLE STEPS
	760000	NDP	
	021736	DID R	
2054	050100	SZA 1	
	002075	JMP STEP	
	040400	SMA	
	761000	CMA	
2060	241735	DAC NN	/FOR INDEXING
	700177	LAW 177	
	221535	LID TEMP1	
	042000	SPI	

2064	047323		IOR 1200	/MINUS SIGN
	047334		IOR 1400	/INTENSITY
	764000		CLI	
	477777		SCR 95	
2070	677001		SCR 15	
	831547		DIO 1 PTHISTO	
	441547		IDX PTHISTO	
	461735		ISP NN	/NO. OF WHOLE STEPS
2074	602071		JMP -3	
2075	201736	STEP,	LAC R	/PUT IN PARTIAL STEP
	450100		SZA 1	
	602110		JMP +9.	
2100	440400		SPA	
	602104		JMP +3	
	761000		CMA	
	047323		IOR 1200	/MINUS SIGN
2104	047334		IOR 1400	/INTENSITY
	465377		SAL 85	
	251547		DAC 1 PTHISTO	
	441547		IDX PTHISTO	
			REPLAY 1,2	/KEEP DISPLAY GOING
2111	201561		LAC NNN	/NUMBER OF WHOLE STEPS IN X DIRECTION
	450100		SZA 1	
	602122		JMP STEP1	
2114	247125		DAC *VARN	
	227335		LTO 1200177	/WHOLE STEPS IN X
	831547		DIO 1 PTHISTO	
	441547		IDX PTHISTO	
2120	467125		ISP VARN	/NUMBER OF WHOLE STEPS
	602116		JMP -3	
2122	201560	STEP1,	LAC RRR	/PARTIAL STEP OVER IN X DIRECTION
	450100		SZA 1	
2124	602130		JMP +4	
	047170		IOR 1200000	/INTENSITY BIT
	251547		OAC 1 PTHISTO	
	441547		IDX PTHISTO	
2130	710001		LAW 1 1	
	401534		ADD TEMP	
	241534		DAC TEMP	
	441533		ISP COUNTER	/TEST IF HAVE DONE ALL PTS
2134	602016		JMP LOOP2	/NO-CONTINUE
2135	201553		LAC SAVEYY	
	440200		SPA	
	761000		CMA	
2140	047336		IOR 11000	
	461377		RAL 85	
	251547		DAC 1 PTHISTO	
	441547		IDX PTHISTO	
2144	703000		LAW 3000	/STOP CODE

2145	251547 437324	OAC I PTHISTO JSP I (TARTTEST REPLAY 1,2	/KEEP DISPLAY GOING
/BUFFER FOR THEORETICAL CURVE IN MODULE 2			
2151	207337 241551	THOR, REPLAY 1,2 LAC (THYTRL+3 OAC TTBL	
2153	200104	LAC THEORY	
2154	450100 402352 200101 440100	SZA I JMP CTRACE LAC FLIPFLOP SZA	/TEST THEOR. BUTTON STATUS /NOT PUSHEO DOWN /CN-CHECK IF HAVE CALCULATED YET /TEST IF HAVE CALCULATED VALUES
2160	402352	JMP CTRACE	/YES, GO ON TO TRACE BUFFER
2161	440101	CALCU, IOX FLIPFLOP	/SO WON'T CALCULATE TWICE
2162	441553 437324	OZM SAVEYY JSP I (TARTTEST	/INITIAL Y COORDINATE
		REPLAY 1,2	/KEEP DISPLAY GOING
2165	200117	LAC MU	/AVERAGE
2170	447205 467342 760000 241555	OPR EXP MUL (1000. OIV (700. NOP	/TO GET GRESTEST POSSIBLE Y VALUE /SET UP FOR DIVISION /POSSIBLE INCREMENTS IN Y DIRECTION
2174	200124 427343 242202 221534	OAC OY LAC GRANULE SUB (6000 OAC INS LIO TEMP	/FACTOR FOR Y SCALE /CREATE DEGRANULATOR
2200	402001 740200 777777 467001	RIL IS CLA	
2204	241536 472001 421535 201535	INS, SCL IS OAC TEMP1+1 RIR IS OIO TEMP1 LAC TEMP1	/DEGRANULATE
2210	451600 407227 427251 241535	CLO ADD (2 AND (377777 OAC TEMP1	
2214	441000 441534 201535 447205	SZO IOX TEMP1+1 LAC TEMP1 MUL (1000.	
2220	472001 421535 241537 201536	RIR IS OIO TEMP1 OAC TEMP1+2 LAC TEMP1+1	

2224	547205	MUL (1000.	
	467777	SCL 95	
	467377	SCL 85	
	401537	ADD TEMP1+2	
2230	241536	DAC TEMP1+1	
	207264	LAC (TEMP1	
	227344	L10 1K915	
		DPR DPDIV	
2235	241535	OAC TEMP1	/INCREMENT EACH TIME
	764000	CLI	
	201534	LAC TEMP	
2240	102202	XCT INS	/LARGEST VALUE
	547345	MUL 1-1000.	
	472001	RIR 15	
	321541	O10 TEMP2	/MOST NEG. NUMBER ' 1000.
2244	201541	LAC TEMP2	
	027346	SUB (500.	
	241541	DAC TEMP2	
	700001	LAW 1	
2250	241733	DAC MIN	/X ALWAYS SAME
	541571	DZM COUNT	
	341741	DZM SW	
		NEXTPT, REPLAY 1,2	/KEEP DISPLAY GOING
2254	700001	LAW 1	
	241733	DAC MIN	
	201535	LAC TEMP1	
	541571	MUL COUNT	
2260	567177	DIV 11	/TO GET INTD AC COMPLIMENTED
	760000	NOP	
	401541	ADD TEMP2	/NOW HAVE X VALUE
		DPR EXP	
2265	547205	MUL (1000.	
	541555	DIV DY	/TO GET COORD.
	760000	NOP	
2270	421553	SLB SAVEYY	/TO GET DIFFERENCE
	241732	DAC MAJ	
	401553	ADD SAVEYY	
	241553	DAC SAVEYY	/TO GET NEXT DIFFERENCE
2274	421616	JSP COORD	
	201741	LAC SW	
	440100	SZA	/TEST WHICH IS LARGER
	402345	JMP XMAX	/X IS
2300	201735	LAC NN	/Y IS-CONTINUE
	450100	SZA 1	/TEST IF ANY WHOLE STEPS
	402320	JMP STEP2	/NO-GO DO PARTIAL
	700177	LAW 177	/YES-PUT THEM IN

2304	221732	LIO MAJ	
	042000	SPI	
	047323	ICR 1200	/MINUS SIGN
	047334	ICR 1400	/INTENSITY BIT
2310	065377	SAL BS	
	047161	ICR 10	/X INCREMENT FOR Y WHOLE STEPS
	077777	SCR 95	
	077777	SCR 95	
2314	031551	OIO I TTBL	
	041551	ICX TTBL	
	061735	ISP NN	/TEST IF HAVE MORE WHOLE STEPS
	002314	JMP -3	/YES DO AGAIN
		STEP2,	REPLAY 1,2 /NOW DO PARTIAL STEP OVER
2321	201736	LAC R	
	047334	ICR 1400	/INTENSITY BIT
	065377	SAL BS	
2324	047177	ICR 11	
	251551	DAC I TTBL	
	041551	ICX TTBL	
	041571	ICX COUNT	
2330	027325	SAS 1915.	/TEST IF HAVE FINISHED
	002253	JMP NEXTPT	/NO-DO NEXT POINT
2332	710001	LAW I 1	/YES - FINISH UP
	001551	ADD TTBL	
2334	241551	DAC TTBL	
	211551	LAC I TTBL	/PICK UP LAST WORD AND PUT IN
	047171	ICR 140000	/ESCAPE BIT
	251551	DAC I TTBL	
2340	041551	ICX TTBL	
	703000	LAW 3000	/STOP CODE
	251551	DAC I TTBL	
		REPLAY 1,2	/KEEP DISPLAY GOING
2344	002352	JMP CTRACE	/NEXT BUFFER AREA
		XMAX,	REPLAY 1,2 /KEEP DISPLAY GOING
2346	201740	LAC RP	
	002322	JMP SKEP2	
2350	001750	K1000,	1000.
	000000	0	/TWO REGISTER CONSTANT

/ROUTINE TO SET UP BUFFER FOR TRACE DISPLAY IN MODULE 2

2352	231530	CTRACE,	CMA	LAC I W3	/NO. OF PTS. IN TRACE
	701000		OAC COUNTER		
2354	241533		CMA	/FOR INDEXING	
	701000		MUL (1200.	/FOR ACCURACY	
	607205		OIV 1850.	/NO. OF INCREMENTS IN AREA OF SCOPE	
	607347		NOP		
2360	700000		OAC ODY	/FACTOR FOR Y	
	241557		LAC (TRACE+3		
	207350		OAC PTRACE		
	241550		OZM SW		
2364	801741				
		REPLAY 1,2		/KEEP DISPLAY GOING	
2366	700001		LAW 1		
	647205		MUL (1200.	/Y INCREMENT CONSTANT	
2370	601557		OIV ODY	/FACTOR FOR BOTH SCALES WILL BE	
	700000		NOP	/THE SAME - SET IT USING Y	
	247124		OAC BORY		
	701000		CMA	/SINCE WILL ALWAYS BE NEGATIVE	
2374	241732		OAC MAJ	/CHANGE IN Y EACH TIME	
	841552		OZM SAVEXX		
		PEAT,	REPLAY 1,2	/KEEP DISPLAY GOING	
2377	201741		LAC SW		
2400	050100		SZA 1		
	002404		JMP .+3		
	221733		LIO MIN		
	021732		OIO MAJ		
2404	211532		LAC 1 W7		
	100124		XCT GRANULE		
	647351		MUL (2500.		
	661557		OIV ODY		
2410	700000		NOP		
	021552		SUB SAVEXX	/TO GET DIFFERENCE	
	241733		OAC MIN		
	401552		ADD SAVEXX		
2414	241552		OAC SAVEXX	/SAVE TO GET DIFFERENCE AGAIN	
2418	021616		JSP COCRD		
	201741		LAC SW	/TEST WHICH DIFFERENCE IS LARGER	
	040100		SZA		
2420	002451		JMP XLARGER	/X IS	
	201735		LAC NN		
	050100		SZA 1		
	002434		JMP STEP3		
2424	207352		LAC (377420	/VECTOR MODE WORD	
	001737		IOR W		
	077777		SCR 95		
	077777		SCR 95		
2430	031550		DIO 1 PTRACE		
	441550		IDX PTRACE		
	461735		ISP NN		

2433	002430	JMP -3	
		STEP3,	REPLAY 1,2 /KEEP DISPLAY GOING
2435	201736	LAC R	
	047334	IOR 1400	
	005377	SAL 85	
2440	041740	IOR RP	
	251550	DAC I PTRACE	
	441550	IOX PTRACE	
	507250	SAD 1THYBL	
2444	002450	JMP +4	
	441532	IOX W7	/TO NEXT X VALUE
	461533	ISP COUNTER	/TEST IF HAVE FINISHED
	002376	JMP PEAT	/NO-CONTINUE
2450	002504	JMP FINUP	/YES-GO FINISH UP
		XLARGER,	REPLAY 1,2 /KEEP DISPLAY GOING
2452	201735	LAC NN	
	050100	SZA I	
2454	002472	JMP STEP4	
	201737	LAC W	
	047334	IOR 1400	
	005377	SAL 85	
2460	047322	IOR 1177	
	221732	LIO MAJ	
	042000	SPI	
	047323	IDR 1200	/MINUS SIGN
2464	077777	SCR 95	
	077777	SCR 95	
	031550	OIO I PTRACE	
	441550	IOX PTRACE	
2470	441735	ISP NN	/NO OF WHOLE STEPS
	002466	JMP -3	
		STEP4,	REPLAY 1,2 /KEEP DISPLAY GOING
2473	201740	LAC RP	
2474	047334	IOR 1400	
	005377	SAL 85	
	041736	IOR R	
	251550	DAC I PTRACE	
2500	441550	IOX PTRACE	
	441532	IOX W7	/TO NEXT X VALUE
	461533	ISP COUNTER	/TEST IF HAVE FINISHED
	002376	JMP PEAT	/NO-CONTINUE
2504	710001	LAW I 1	
	401550	ADO PTRACE	
	241550	OAC PTRACE	
	211550	LAC I PTRACE	/PICK UP LAST WORD AND PUT IN
2510	047171	IDR 140000	/ESCAPE BIT
	251550	DAC I PTRACE	

2512	841550	1DX PTRACE	
	703000	LAW 3000	/STOP CODE
2514	251550	DAC 1 PTRACE	
	207353	LAC (3000)6	
	241532	DAC N7	
2520	600000	REPLAY 1,2	/KEEP DISPLAY GOING
		JMP .-	/BACK TO MAIN PGM.

/BASELINE FUNCTIONS

2521	262525	RADTAP,	DAP .+4
	702526		LAW .+4
	227354		LIO 134.
2524	170451		JDA TYPE
	602525		JMP .
			TEXT /
2526	776261	BA	
	640071	D I	
2530	454724		APU
	230023		T T
	614765		APC
2533	776346	CO	
2534	456471		NDI
	237146		TIO
	450071		N I
	674546		GNO
2540	516564		REC
2541	737700		.

DEFINE NAMECART N

LAC N

MUL (7

OIV (1

NOP

ADD (NAME-6

OAC XCC

LAC I XCO

ADD (20

DAP I (NAMECART+1

ICX XCC

LAC I XCO

ADD (30

OAP I (NAMECART+2

REPLAY 1,2,NAMECART

TERMINATE

2542	262731	INIT,	DAP INITX
			STZ FLIPFLOP,REDEFN.TIME,THEORY,ECFIND,SX,SX 1
			STZ PROCEED,CHNSEL,TIMGAT,STYLE,SXS 3,SXS 2,SXS,SXS 1
			STZ NCP,MU,MU 1,SIGMA,N,STATUS,PRES,TOTAL,TOTAL+1
			STZ F*MCNTR,TEMP,1 (INFO1,1 (INFO1+1,1 (INFO2,1 (INFO2+1,1 (INFO3
			SET TIMGAT,1 /INITIAL STATUS IS FRAME BY FRAME
			IRP B,,P,1,2,3,4,5,6,7*

		B.,	DZM I (NAME+3+8*7
			DZM I (NAME+4+8*7
2606	857362		ENDIRP
	857363	0,	DZM I (NAME+3+0*7
2610	857364		DZM I (NAME+4+0*7
	857365		1, DZM I (NAME+3+1*7
	857366		DZM I (NAME+4+1*7
	857367		2, DZM I (NAME+3+2*7
2614	857370		DZM I (NAME+4+2*7
	857371		3, DZM I (NAME+3+3*7
	857372		DZM I (NAME+4+3*7
	857373		4, DZM I (NAME+3+4*7
2620	857374		DZM I (NAME+4+4*7
	857375		5, DZM I (NAME+3+5*7
	857376		DZM I (NAME+4+5*7
	857377		6, DZM I (NAME+3+6*7
2624	857400		DZM I (NAME+4+6*7
	857401		7, DZM I (NAME+3+7*7
	700100		DZM I (NAME+4+7*7
	257216		LAW 100
			DAC I ICHANNELS+6

2630	700200	LAW 200		
	257220	DAC I (CHANNELS+7		
	700300	LAW 300		
	257222	DAC I (CHANNELS+8.		
2634	700400	LAW 400		
	257402	DAC I (CHANNELS+9.		
	207403	LAC (34117		
	257210	DAC I (DATA		
2640	207404	LAC 1220207		
	257405	DAC I (DATA+1		
	207406	LAC 1100066		
	257407	DAC I (DATA+2		
2644	207171	LAC (400000		
	257326	DAC I (DATA+3		
	7003000	LAW 3000		
	257410	DAC I (DATA+4		
2650	347120	DZM %FMCNTR		
	207411	LAC (TABLE		
	247127	DAC %KTABLE		
	357127	DZM I KTABLE		
2654	447127	ICX KTABLE		
	527327	SAS IMAX(MUM		
	402653	JMP *-3		
	700200	CLA		
000000				
		B=0		
		REPEAT 8.,	DAP I (LIMITS+1*B	DAP I (LIMITS+2*B DAP
2720	760007	CLF 7		
	227452	LID (INITXL		
	720025	DLA		
		REPLAY		
2731	002731	JMP *		
	034130	34130		
	020006	20066		
2734	261761	261761	/A DISPLAY (DARK) TO SET STOP FLAG	
	000013	13		
	003000	3000		
2737	037453	BG71,	JSP I (SUM	
2740	200124		LAC GRANULE	
	027454		AND (-10000	
	242746		DAC 9500	
	217455		LAC I (TTT+10000	
2744	427271		SUB IZLOC	
	075001		SAR 15	
	777777	9500,	*-.	
	247130		DAC 95710	
2750	217456		LAC I (TT+10000	
	027271		SUB IZLOC	
	075001		SAR 15	
	102746		XCT 9500	
2754	427130		SUB 9570	
	040200		SPA	
	761000		CMA	

2757	243550		OAC 7C8	/AES, VALUE OF DATA-MU
2760	207457		LAC (CUMSUM+10000	
	227332		LIO (K1000	
			OPR UMUL	
2764	001535		TEMP1	
	207264		LAC (TEMP1	
	227277		LIO (TCTAL	
			OPR DPO1V4	
2771	001535		TEMP1	
	201535		LAC TEMP1	
	243551		DAC 7C9	
2774	200122		LAC XYNOW	
	065001		SAL 15	
	027460		AND (1777	
	047461		ICR (2000	
3000	277462		DAP 1 (DATA+1	
	200122		LAC XYNOW	
	073777		RGR 95	
	061001		RAL 15	
3004	027460		AND (1777	
	047461		ICR (2000	
	277463		DAP 1 (DATA+2	
			REPLAY 1,2,DATA	
3015	447131		ICX (INTERPRO	
	005463		JMP RG100	
3017	207465	RG72,	LAC (100*512,+50	
3020	240122		DAC XYNOW	
	037453		JSP 1 (SUM	
			NEXTCRT CRTDC	
3024	217466		LAC 1 (TEMP	
	065001		SAL 15	
	761000		CMA	
	407271		ADD (ZLOC	
3030	247132		DAC TOMMY	
	217132	TAOR,	LAC 1 TOMMY	
	040100		SZA	
	003036		JMP .+3	
3034	447132		ICX TOMMY	
	003031		JMP TAOR	
	217466		LAC 1 (TEMP	
	065001		SAL 15	
3040	407271		ADD (ZLOC	
	247133		DAC TOMMY	
	217133	TIACR,	LAC 1 TOMMY	
	040100		SZA	
3044	003051		JMP .+5	
	710001		LAW 1 1	
	407133		ADD TOMMY	
	247133		DAC TOMMY	
3050	003042		JMP TIACR	
	207132		LAC TOMMY	
	427271		SUB (ZLOC	

8053 875001
 8054 863777
 863777
 200124
 027454
 8060 243063
 863777
 863777
 777777
 8064 243547

SAR IS
 RCL 9S
 RCL 9S
 LAC GRANULE
 AND (-10000
 DAC 7358Y
 RCL 9S
 RCL 9S
 7358Y, - /DEGRANULATION
 DAC 7C7

DEFINE PROBSIG SIG1,SIG2,SIG3
 DZM SUM1
 DZM SUM1+1
 LAC SIGMA
 SAL SIG1 /SIG3* SIGMA
 MUL 11
 DIV 1100.
 NOP
 XCT GRANULE
 SAL 1S /SINCE DOUBLE PRECISION
 ADD 1ZLOC+2
 DAC TEMP1
 SUB 1ZLOC+2
 CMA
 ADD 1ZLDC
 DAC C*SUM /ADDRESS OF -SIG3*SIGMA TALLY
 LIO CSUM /PUT INTO ID
 LAW SUM1
 DPR DADD
 SUM1
 LAW 2 /GO ON TO NEXT TALLY REGISTERS
 ADD CSUM
 DAC CSUM
 SUB TEMP1
 SPA
 JMP -10.
 LAC 1SUM1
 LIO 1K1000
 DPR CMUL
 TEMP1
 LAC 1TEMP1
 LIO 1TOTAL
 DPR OPDIV4 /PROBABILITY OF GETTING A VALUE
 TEMP1 /BETWEEN *+ SIGMA*SIG3
 LAC TEMP1
 DAC SIG2

TERMINATE

PROBSIG 0,7C2,1
 PROBSIG 1S,7C3,2
 PROBSIG 2S,7C4,3
 EQUALS PROBSIG,NULL

3247	217456	LAC 1 (TT+10000
3250	227332	LIO (K1000
		OPR OMUL
3253	001535	TEMP1
3254	007264	LAC (TEMP1
	227277	LIO (TOTAL
		DPR DPCIV4
3260	001535	TEMP1
	201535	LAC TEMP1
	243541	OAC 7C1
	207133	LAC TDMK
3264	027271	SUB (7LOC
	075001	SAR 15
	103063	XCT 7358Y
	243546	DAC 7C6
3270	200124	LAC GRANULE
	027473	ANO (777
	007177	ADD (1
	243545	OAC 7C5
		/GRANULARITY
		DEFINE CARRIAGE
		LIO (77
		JDA 9PT
		TERMINATE
		DEFINE MEMBER A,B,C,D
		LAC (A
		LIO (B
		JDA TYPE
		CLI
		JDA 9PT
		CLI
		JDA 9PT
		LAC C
		REPEAT 11F V7 D+0,
		REPEAT 01F V7 D+0,
		CARRIAGE
		TERMINATE
		DEFINE CARRIAGE
		LAW 8C43
		DAP MDVTR-1
		JMP BG3
		LAW 8GN4
		DAP MDVTR-1
		CARRIAGE
		CARRIAGE
		LAC (8C1
		LIO (8CC1
		JDA TYPE
		CLI
		JDA 9PT
3276	703301	
	264563	
3300	004515	
	704213	
	264563	
3307	207475	
3310	227476	
	170451	
	764000	
	170550	

3310	704000		CLI
	170550		JCA 9PT
	200125		LAC TOTAL
	547177		MUL (1
3320	567477		DIV (100000.
	700000		NOP
	650100		SZA 1
	603335		JMP BCB7
3324	440124		IDX TOTAL+1
	663777	BCB4,	RCL 95
	663777		RCL 95
	240125		DAC TOTAL
3330	200126		LAC TOTAL+1
	170513		JCA DPT
	200125	BCB6,	LAC TOTAL
	170513		JCA DPT
3334	603341		JMP BCB5
	200126	BCB7,	LAC TOTAL+1
	640100		SZA
	603325		JMP BCB4
3340	603332		JMP BCB6
		BCB5,	CARRIAGE
			MEMBER BC2,BCC2,MU,1
			MEMBER BC3,BCC3,7C1,1
			MEMBER BC3A,BCC3A,7C1A,1
			MEMBER BC4,BCC4,7C2,1
			MEMBER BC5,BCC5,7C3,1
			MEMBER BC6,BCC6,7C4,1
			MEMBER BC7,BCC7,7C5
			MEMBER BC8,BCC8,7C6
			MEMBER BC9,BCC9,7C7
3506	207131		LAC INTER*RO
	650100		SZA 1
3510	603537		JMP BGT2X
			MEMBER BC10,BCC10,7C8
			MEMBER BC11,BCC11,7C9,1
3537	347131	BGT2X,	DZM INTERRC
3540	605463		JMP BGT00
3541	777777	7C1,	.-.
	000121	7C1A=SIGMA	
3542	777777	7C2,	.-.
	777777	7C3,	.-.
3544	777777	7C4,	.-.
	777777	7C5,	.-.
	777777	7C6,	.-.
	777777	7C7,	.-.
3550	777777	7C8,	.-.
	777777	7C9,	.-.
000033		BCC1=27.	

#####12
#####31
#####46
#####46
#####46
#####22
#####17
#####17
#####48
#####68
#####13

BCC2=10.
BCC3=25.
BCC4=38.
BCC5=38.
BCC6=38.
BCC7=18.
BCC8=15.
BCC9=15.
BCC10=32.
BCC11=48.
BCC3A=11.

SUM1, REPEAT 2, 0

3554	203634	DSDS1,	DAP DSDS1X	/DISPLAY INFO
	023635	JSP DINIT1	/SET UP DECIMAL PRINT TO PACK	
	020221	INFD1		
	200121	LAC SIGMA		
3560	170602	JDA PRID		
	023635	JSP DINIT1		
	020236	INFD2		
	207126	LAC FIMCNTR		
3564	170513	JCA DPT		
	201554	LAC DX		
	407161	ADD I0		
	050100	SZA I		
3570	003633	JMP DSDS1X-1		
	023635	JSP DINIT1		
	020251	INFD3		
	201534	LAC TEMP		
3574	050100	SZA I		
	003603	JMP -+6		
	200124	LAC GRANULE		
	427343	SUB I6000	/CREATE DEGRANULATOR	
3600	243602	DAC .+2		
	201534	LAC TEMP		
	177777	-.-	/DEGRANULATION	
	170513	JCA DPT		
3604	701750	LAW I000.		
	547177	MUL I1		
	561554	DIV DX		
	700000	NDP		
3610	247135	DAC FLIPF	/DELTA X	
	201534	LAC TEMP		
	547205	MUL I1000.		
	567177	DIV I1		
3614	760000	NDP		
	400117	ADD MU		
	407346	ADD I500.		
	547135	MUL FLIPF		
3620	567205	DIV I1000.		
	760000	NDP		
	407521	ADD I66		
	277522	DAP 1 (CRTMU+2		
3624	277523	DAP 1 (CRTMU+6		
		REPLAY I,2,CRTMU		
3630	023663	JSP DINIT2		
3634	003634	JMP .		
		DSDS1X,		
3638	263662	DINIT1,	DAP IDNT	
	207525		LAC (XCT RG15	
	244466		DAC RG14	
3640	720074		LEM	
	213662		LAC 1 IDNT	
	724074		EEM	
	247135		DAC FLIP*F	
3644	557135		DZM I FLIPF	

3649	047135		IDX FLIPF
	057135		DZM I FLIPF
	047135		ICX FLIPF
3650	357135		DZM I FLIPF
	710002		LAW I 2
	007135		ADD FLIPF
	247135		DAC FLIPF
3654	043662		ICX IDNT
	207526		LAC (JMP 0G14
	240123		DAC ID
	207527		LAC (JMP 7ZGF
3660	244476		DAC M4Z
	244503		DAC M3Z
	003662	IDNT,	JMP .
3663	263700	DINIT2,	DAP IDCZ
			PUNCH
3675	207530		LAC (JMP 0G13
	244476		DAC M4Z
	244503		DAC M3Z
3700	003700	IDCZ,	JMP .
3701	263714	DSDS2,	DAP DSDX
	023635		JSP DINIT1
	020264		TAPINF
3704	217531		LAC I (30000
	027473		AND (777
	170513		JDA DPT
	023635		JSP DINIT1
3710	020277		TAPINK
	217532		LAC I (30001
	170513		JDA DPT
	023663		JSP DINIT2
3714	000000	DSDX,	JMP

START

```

BASELINE 3
OCTAL

3713 203724 7W1, OAP .+7
      003777 RCL 9S
      003777 RCL 9S
3720 071077 RAR 6S
      027533 ANO (770000
      003777 RCL 9S
      003777 RCL 9S
3724 003724 JMP .

3728 203734 7W2, OAP .+7
      003777 RCL 9S
      003777 RCL 9S
3730 001077 RAL 6S
      027534 ANO (7700
      003777 RCL 9S
      003777 RCL 9S
3734 003734 JMP .

3738 263743 7W3, OAP .+6
      003777 RCL 9S
      003777 RCL 9S
3740 027474 ANO (77
      003777 RCL 9S
      003777 RCL 9S
      003743 JMP .

XTAG, REPLAY 1,2,0,TRACE
IRP B,,0,1,2,3,4,5,6,7#
B,, REPLAY 1,2,0,LIMITS+B*19.
ENDIRP
0, REPLAY 1,2,0,LIMITS+0*19.
  1, REPLAY 1,2,0,LIMITS+1*19.
  2, REPLAY 1,2,0,LIMITS+2*19.
  3, REPLAY 1,2,0,LIMITS+3*19.
  4, REPLAY 1,2,0,LIMITS+4*19.
  5, REPLAY 1,2,0,LIMITS+5*19.
  6, REPLAY 1,2,0,LIMITS+6*19.
  7, REPLAY 1,2,0,LIMITS+7*19.
JMP XTAG1

0032 005050 BGN, EEM
      0033 024074 IOT 211 /SELECT THE CONSOLE BUTTONS FOR CONTROL
      0034 020211 REWIND TAPE /INPUT TAPE IS ON UNIT 5
      0040 047136 BGN1, OZM O'LYT
      007546 LAC (TEXTLINES+3
      247112 OAC XCO
      227547 LTO (202020
      0044 007112 DIO I XCO
      047112 ICX XCO
      027550 SAS (CHANNELS-2 /INPUT TITLE BUFFER INITIALIZED
      004044 JMP .-3 /TO IBM TAPE BLANKS.
      PUNCH
      TAPRED ONSTY,TAPE,2,TEXTLIES+3,20066,JMP BGN1
      0077 207546 BGN2, ISET NUMCHN,1 /INITIALIZE NUMBER OF CHANNELS
      0100 247112 LAC (TEXTLINES+3
      OAC XCO
      6HH, ISET 5*HH,3

```

4103	237112		L10 1 XCO
4104	760200	4HH,	CLA
	663077		RCL 6S
	760005		CLF S
	650100		SZA 1
4110	760015		STF S
	907206		SAD (20
	760200		CLA
	640100		SZA
4114	604117		JMP .+2+1
	640005		SZF S
	700020		LAW 20
	673077		RCR 6S
4120	662077		RIL 6S
	667137		ISP 5HH
	604104		JMP 4HH
	837112		D10 1 XCD
4124	447112		10X XCD
	627550		SAS (CHANNELS-2
	604101		JMP 6HH
4143	217531	BGN3,	TAPRED DNSTY,TAPE,1,30000,37777,JMP BGN2
4144	661777		LAC 1 (30000 /GET CHANNEL NUMBER
	027232		RAL 9S /RIGHT JUSTIFY
	420112		ANO (3 /MASK OUT GARBAGE
	007161		SUB NUMCHN /COMPARE WITH PREVIOUS VALUE
4150	640400		ADD (0 /ELIMINATE -0
	605552		SMA /HAVE WE FOUND ALL THE CHANNELS YET
	207554		JMP BGN3 /NO SO KEEP GOING
	244165		LAC (NOP
			OAC .+10.
4162	604154	BGK,	TAPSPC DNSTY,TAPE,1,-40,JMP BGK1
			JMP BGK
4204	022542	BGK1,	TAPRED DNSTY,TAPE,2,30000,37777,JMP BGN2
			/THE ABOVE RESETS THE TAPE
			JSP INIT /GO INITIALIZE THE PROGRAM
		BGN4,	REPLAY 0,1,CHANNELS
			REPLAY 1,2,CHANNELS
			PUNCH
			REPLAY 1,1,TEXTLINES
			REPLAY 1,2,CONTINUE
			REPLAY 1,2,NEXTFILE
4254	467136		ISP OL*YT
	604213		JMP BGN4
	047136		OZM OLYT
			RESPOND 0,BGN4,BG1,BG2,BG3,BG4,BG5,BG6, BG7,BG8,BG9
		BG1,	REPLAY 1,0
			NEXTCRT CRTNF
			TAPSPC DNSTY,TAPE,1,40,JMP BGN1
4330	604305		JMP BG1 /SPACE TO NEXT E20.F.
	840113	BG5,	OZM CHNSEL /RESET CHANNEL SELECT REGISTER
	700100		LAW 100
	257216		DAC 1 (CHANNELS+6 /RESET DISPLAY BUFFER
4334	700200		LAW 200 /TO GIVE ALL FOUR NUMBERS
	257220		OAC 1 (CHANNELS+7 /10., *CHANNELS 1234*

```

DEFINE BUTEST A,B
LAT
REPEAT 11F VZ A-17., RAR 1S
REPEAT 11F VZ A-16., RAR 2S
REPEAT 11F VZ A-15., RAR 3S
REPEAT 11F VZ A-14., RAR 4S
REPEAT 11F VZ A-13., RAR 5S
REPEAT 11F VZ A-12., RAR 6S
REPEAT 11F VZ A-11., RAR 7S
REPEAT 11F VZ A-10., RAR 8S
REPEAT 11F VZ A-9., RAR 9S
REPEAT 11F VZ A-8., RAR 10S
REPEAT 11F VZ A-7., RAR 11S
REPEAT 11F VZ A-6., RAR 12S
REPEAT 11F VZ A-5., RAR 13S
REPEAT 11F VZ A-4., RAR 14S
REPEAT 11F VZ A-3., RAR 15S
REPEAT 11F VZ A-2., RAR 16S
REPEAT 11F VZ A-1., RAR 17S
SPA /IS BUTTON A ON
JMP B /YES, SO EXIT ACCORDINGLY

TERMINATE
LAW 300
DAC 1 (CHANNELS +8.
LAW 400
DAC 1 (CHANNELS+9.
JMP BG11 /RETURN AND DISPLAY
BG6, LAW 1 /CHANNEL 1 SELECTED
JMP .+6
BG7, LAW 2 /CHANNEL 2 SELECTED
JMP .+4
BG8, LAW 3 /CHANNEL 3 SELECTED
JMP .+2
BG9, LAW 4 /CHANNEL 4 SELECTED
DAC CHNSEL /SAVE CHANNEL NO.
REPLAY 1,2,,CHNSEL
LAC (LAW 1
DAC .+3 /INITIALIZE CHANNEL NO. GENERATOR
LAC (CHANNELS+6 /GET INITIAL OUTPUT ADDRESS
DAC *FLIPF /SAVE ADDRESS
BG10, .- /LAW TO CHANNEL NO.

SAD CHNSEL /IS THIS THE SELECTED CHANNEL
JMP .+2 /YES, SO SAVE IT.
DZM 1 FLIPF /NO, SO DESTROY THIS NO. DISPLAY
ICX FLIPF /UPDATE OUTPUT ADDRESS
ICX BG10 /UPDATE CHANNEL GENERATOR
SAS (LAW 5 /ARE WE DONE
JMP BG10 /NO, SO CONTINUE
BG11, JMP BGN4 /YES, SO RETURN TO DISPLAY
BG4, LAC (TEXTLINES+3 /GET STARTING ADDRESS OF TEXT
DAC FLIPF /SAVE FOR INDIRECT ADDRESSING
NEXT CRTI
DZM 1 FLIPF /INITIALIZE TEXT TO SPACES

```


4403	407135	ICX FLIPF	/UPDATE TEXT BUFFER POINTER
4404	527550	SAS (CHANNELS-2	/ARE WE DONE YET\$
	004402	JMP -3	
	207546	LAC (TEXTLINES+3	/GET STARTING ADDRESS OF TEXT
	247135	DAC FLIPF	/SAVE FOR INDIRECT ADDRESS
4410	207525	LAC (XCT BG15	/INITIALIZE PROCKED WORD
	244466	OAC BG14	/INITIALY PACKER
	760001	CLF 1	
		REPLAY 0,0	/RESET THE DISPLAY
		REPLAY 1,2,TEXTLINES	
		REPLAY 1,1,CONTINUE	
		RESPOND 0,BG12,,BG5N4	
4463	650001	SZF 1 1	/TYPEWRITER INPUT\$
4464	604421	JMP BG13	/NO
	720004	TYI	/YES
	777777	-	
4470	063777	RCL 95	/PUT CHARACTER IN AC
	063777	RCL 95	
	057135	IDR 1 FLIPF	/PUT CHARACTER IN TEXT
	257135	DAC 1 FLIPF	
	760001	CLF 1	
4474	044466	IOX BG14	
	627562	SAS (XCT BG15+3	/HAVE WE DONE 3 CHARACTERS
	004421	JMP BG13	/NO
	207525	LAC (XCT BG15	/YES, SD RESET PACKER
4500	244466	OAC BG14	
	447135	IOX FLIPF	/UPCATE TFXT POINTER
	527550	SAS (CHANNELS-2	/HAVE WE EXCEEDED THE BUFFER
	004421	JMP BG13	/NO
4504	004213	JMP BGN4	/YES, SD 'HIT' 'CONTINUE'
		NEXTCRT 0	
		ISCT D'LYT,1000	
		JMP BGN4	
4512	604213	JSP 7W1	
	423715	JSP 7W2	/PACKING INSTRUCTIONS
	023725	JSP 7W3	
4514	023735	LIO 177	
	227474	JDA 9PT	/TYPE A CARRIAGE RETURN
	170550	NEXTCRT CPTO	
		REPLAY 1,0	
4527	207546	LAC (TEXTLINES+3	
4530	247112	OAC XCD	
	347135	OZM FLIPF	
	217112	LAC 1 XCD	
	040100	SZA	
4534	004542	JMP -+6	
	047135	IOX FLIPF	
	047112	IOX XCD	
	527550	SAS (CHANNELS-2	
4540	004532	JMP GB	
	004544	JMP -+2	
	347135	OZM FLIPF	
	004536	JMP -5	

0544	207563		LAC (3*CHANNELS-3*TEXTLINES-15.
	027135		SUB FLIPF
	027135		SUB FLIPF
	027135		SUB FLIPF
0550	003777		RCL 95
	003777		RCL 95
	207546		LAC (TEXTLINES 3
	170451		JDA TYPE /TYPE OUT TITLE
0554	227474		LIO (77
	170550		JDA 9PT
	207564		LAC (CHANNELS+3
	227200		LIO (10. /TYPE THE WORD 'CHANNELS'
0560	170451		JDA TYPE
	220113		LIO CHNSEL
	170550		JDA 9PT /TYPE THE CHANNEL NUMBER SELECTED
	004213		JMP BGN4 /GO BACK AND MONITOR DISPLAY
0564	247112	MOVTR,	DAC XCD
	004636		ISP MOVDEL
	005037		JMP B6
	207112		LAC XCD
0570	073001		RCR 15
	207171		LAC (ADD
	052000		SPI I
	207565		LAC (SUB
0574	004576		DIP MOVDIR
	217566		LAC I (TRACE+2
	007177	MOVDIR,	AND (1
	027460		AND (1777
0600	047567		IDR (100000
	257566		DAC I (TRACE+2
	201562		LAC N
	050100		SZA I
0604	004633		JMP B044
	761000		CMA
	247112		DAC XCD
	207413		LAC (LIMITS+2
0610	247135		DAC FLIPF
	217135	MOVBC,	LAC I FLIPF
	104576		XCT MOVDIR
	027460		AND (1777
0614	047567		IDR (100000
	257135		DAC I FLIPF
	700011		LAW 9.
	007135		ADD FLIPF
0620	247135		DAC FLIPF
	217135		LAC I FLIPF
	104576		XCT MOVDIR
	027460		AND (1777
0624	047567		IDR (100000
	257135		DAC I FLIPF
	700012		LAW 10.
	007135		ADD FLIPF
0630	247135		DAC FLIPF

4631	467112		ISP XCD
	604611		JMP MOVBCX
	710003	B644,	LAW I 3
4634	244636		DAC MOVDEL
	605037		JMP B6
	000000	MOVDEL,	R
4637	200113	BG2,	LAC CHNSEL
4640	650100		SZA I
	605626		JMP BG9B /ILLEGAL CHANNEL SELECT
	420112		SUB NUMCHN
	640500		SZM
4644	605626		JMP BG9B /NOT THAT MANY CHANNELS ON THE TAPE
			NEXTCRT CRTCON
			REPLAY 1,0,0,CHNMES
4655	200113		LAC CHNSEL
	427177		SUB (1 /GET NO. OF RECORDS TO SHIP
	244670		DAC .+9. /TO START OF JOP
			TAPSPC DNSTY,TAPE,1,0,JMP BGN1
			TAPRED DNSTY,TAPE,1,30000,37777,JMP BG97
4707	625707		JSP FIXDAT
			REPLAY 1,0
		BG40,	REPLAY 1,2,TEXTLINES,NEXTFILE
			REPLAY 1,2,CHANNELS,CONTINUE
			REPLAY 1,2,BASELN
			REPLAY 1,2,INFO
			REPLAY 1,2,TRACE
			REPLAY 1,2,DATA
			BUTEST 11,000 /IS THE THEORETICAL BUTTON ON?
4766	605226		JMP B999 /NO
	200101	B88,	LAC FLIPFLOP
4770	650100		SZA I
	605226		JMP B999
			REPLAY 1,2,THYTEL
5000	201562	B999B,	LAC N
	650100		SZA I
	605024		JMP B5 /NO LIMITS, SO DON'T DISPLAY
	761000		CMA
5004	247135		DAC FLIPF
	207252		LAC ILIMITS
	247137		DAC SHF
	207137	B8B7,	LAC SHH
5010	605013		JMP .+3 /SKIP OVER AC PICKUP
			REPLAY 1,2,LIMITS
5017	207137		LAC SHF
5020	407251		ADD (19.
	247137		OAC SHH
	467135		ISP FLIPF /ARE ALL LIMIT PAIRS DISPLAYED
	605007		JMP B8B7 /NO SO LOOP BACK FOR REST.
5030	764000	PS,	BUTEST 12,0,BG46 /STOP
	762200		CLI
	673777		LAT
	673007		RGR 95
			RGR 35

5034	027232	AND 13
	040100	SZA
	004564	JMP MOVTR
5043	340104	B6,
		BUTEST 11.,BG47 /THEORY
		DZM THEORY /DO NOT CALCULATE THEORETICAL BELL
		B7,
		BUTEST 10.,BG48 /LIMITS
		XTAG1,
		BUTEST 3,XTAG
		REPLAY 1,2,TRACE
		IRP 9.,0,1,2,3,4,5,6,7#
		REPLAY 1,2,LIMITS+B*19.
		B.,
		ENDIRP
		0,
		REPLAY 1,2,LIMITS+0*19.
		1,
		REPLAY 1,2,LIMITS+1*19.
		2,
		REPLAY 1,2,LIMITS+2*19.
		3,
		REPLAY 1,2,LIMITS+3*19.
		4,
		REPLAY 1,2,LIMITS+4*19.
		5,
		REPLAY 1,2,LIMITS+5*19.
		6,
		REPLAY 1,2,LIMITS+6*19.
		7,
		REPLAY 1,2,LIMITS+7*19.
		BB,
		BUTEST 9.,BG49 /TIME
		REPLAY 1,2,0,FRAME
		REPLAY 1,2,0,TIMCRT
		REPLAY 1,2,0,TIMCRT+6
		REPLAY 1,2,0,TIMCRT+12.
		REPLAY 1,2,0,TIMCRT+18.
5204	200114	B10,
	040100	LAC TIMGAT /TIME GATE
	005235	SZA /ON OR OFF\$
	400111	JMP BG60 /ON
5210	004716	ISP TOC /LPOATE TIME DELAY CLOCK
	200115	JMP BG40 /CLOCK NOT YET DONE
	227574	LAC STYLE /TIME TO GET NEXT FRAME
	307227	L10 (-1
5214	220110	SAO 12 /MODERATE SPEED
	007177	L10 TD2
	220107	SAD 11 /SLOW SPEED
	050100	L10 TD1
5220	227257	SZA 1 /FRAME BY FRAME
	063777	L10 1377777
	003777	RCL 95
	701000	RCL 95
5224	240111	CMA
	005406	OAC TOC /RESET TIME DELAY CLOCK
		JMP BG70
5234	005000	B999,
	762200	REPLAY 1,2,0,THYTB1
	475777	JMP B999B
	027177	BG60,
	000106	LAT /GET BUTTONS
	005244	SAR 95 /ELIMINATE ALL BUT PROCEED BUTTON
	240106	ANO 11
	005406	SAO PROCOO /CHAR. BUTTON CHANGED\$
		JMP BG7B2 /NO, SO CHECK IF FRAME SHOULD BE SKIPPED
		DAC PROCOO /YES, SO SAVE PRESENT ATATUS
		JMP BG70
5250	004716	BG7B2,
		BUTEST 0,RG7B1
		JMP BG40
5254	005412	BG7B1,
		BUTEST 6,RG7B1K
		JMP RG70K
5257	005251	BG7B1K,
	700001	REPLAY 1,2
5260	240104	JMP RG7H1
	005044	BG47,
		LAW 1
		DAC THEORY /SET THEORY BUTTON STATUS TO ON
		JMP B7 /TEST REMAINING BUTTONS

	700001	BG49,	LAW 1	
		,		
5264	240103			OAC TIME
				REPLAY 1,1,FRAME
				REPLAY 1,2,0,TIMCRT
				REPLAY 1,2,0,TIMCRT+6
				REPLAY 1,2,0,TIMCRT+12.
				REPLAY 1,2,0,TIMCRT+18.
5323	200115			LAC STYLE
5324	347217			MUL (6
	567177			DIV (1
	760200			NOP
	407253			ADD (TIMCRT
5330	005333			JMP .+3
				REPLAY 1,1
				RESPOND 0,BG40,.....,BGG00,BGG01,BGG02,BGG03
5365	700001	BGG00,	LAW 1	
	240114		DAC TIMGAT	/TURN ON TIME GATE
	340115		DZM STYLE	/SELECT FRAME MODE
5370	604716		JMP BG40	
	200107	BGG01,	LAC TU1	/SLDW
	227177		LIO (1	
	605401		JMP .+6	
5374	200110	BGG02,	LAC TD2	/MODERATE
	227227		LIO (2	
	405401		JMP .+3	
	710001	BGG03,	LAW 1 1	/FAST
5400	227232		LIO (3	
	761000		CMA	
	240111		DAC TDC	/SET UP TIME CLOCK
	320115		DIO STYLE	/SELECT PROPER MODE
5404	340114		OZM TIMGAT	/TURN OFF TIME GATE
	604716		JMP BG40	
	340101	BG70,	DZM FLIPFLOP	/INSURE NEW THEORETICAL BELL
	621254		JSP CALCUL	/CALCULATE HYSTOGRAM AND BELL
5410	447126		IOX FMCNTR	
	423554		JSP DS051	/DISPLAY INFO
	710001	BG70K,	LAW 1 1	
	400112		ADD NUMCHN	
5414	245425		OAC .+9.	
			TAPSPC DNSTY,TAPE,1,0,JMP BGN1	
			TAPRED DNSTY,TAPE,1,30000,37777,JMP BG99	
5444	625707		JSP FIXDAT	
	217575		LAC 1 (30002	
	427217		SUR (6	
	440200		SPA	
5450	405412		JMP BG70K	
	427576		SUB (5000.	
	440400		SMA	
	405412		JMP BG70K	/THIS FRAME HAS TOO MANY POINTS
5454	423701		JSP DS052	/EMPTY FRAME SO SKIP AND DISPLAY TAPE 1.D.
	104716		LAW BG40	
	262520		OAP RETURN	
	602352		JMP CTRACE	
5460	700001	BG99,	LAW 1	
	240105		DAC EOFIND	/MARK END OF FILE CONDITION

5462	847131	BG46, BG122,	OZM INTERRO /ZERO INTERRO BUFFER REPLAY 1,1,INFO REPLAY 1,2,THISFILE REPLAY 1,2,DOCUMENT REPLAY 1,2,CHANNELS PUNCH
5552	800112 240112	HGNN3,	RESPOND 0,BG120,BG74,ABC4,,,,,,,,,,,,,BG73,BG71,BG72,BG71 ADD NUMCHN /LOOKING FOR NO. OF CHANNELS OAC NUMCHN /SAVE THIS INTERUM VALUE JMP BGN3 /AND HEEP GOING
5554	604127	BG74,	BUTEST 12., BG76 /IS STOP BUTION ON\$ NEXTCRT CRTNE LAC EOFIND
5563	200105		
5564	650100 604305 840105 604040		SZA I /NO, SO IT END.F. INDICATOR ON\$ JMP BGI /NO, SO CONTINUE WITH THIS FILE. OZM EOFIND /YES, SO TURN OFF JMP BGN1 /AND TAKE NEXT FILE
5576	605555	BG76, BG73,	REPLAY 1,0,SORRY JMP BG74 BUTEST 12.,BG77 /IS STOP BUTION ON\$ NEXTCRT CRTTF
5605	604154	BG77,	JMP BGN /START THIS FILE OVER AGAIN REPLAY 1,0,SORRY PUNCH
5625	405577	BG9A,	JMP BG73 REPLAY 1,2,CHNMES JMP BGN4
5634	604213	ABC4,	NEXTCRT CRTCON BUTEST 12.,ABC5 REPLAY 1,2,0,SORRY REPLAY 1,2,0,THISFILE REPLAY 1,2,0,DOCUMENT REPLAY 1,2,0,DATA LAC EOFIND
5673	200105		SZA I
5674	650100 604716 240105 604040		JMP BG40 OZM EOFIND JMP BGN1
5706	605635	ABC5,	REPLAY 1,2,SORRY JMP ABC4
5707	265724	FIXOAT,	DAP .+13. LAC I W5 ADD I2 CPA OAC ELIPF LAC I W7 SAR B5 OAC I W7 ICX W7 ISP ELIPF JMP .-5 LAC I30006 DAC W7 JMP .-.
5710	211530 407227 761000 247135		
5714	211532 675377 251532 441532		
5720	467135 605714 207353 241532		
5724	600000		

/LIMIT BUTTON PROCESS CONTROL

		DEFINE	SETNAME	
			LAC 'FIRSTX	/0 MEANS NOT WORKING ON A NEW SET.
			SZA I	
			JMP .+4	/LEAVE SET DEFN ALDNE
			IDX N	/SET UP FOR NEW LIMITS SET.
			DZM 'FIRSTX	
			DZM 'SETDEF	/DEFN COMPLETE INDICATOR
		TERMINATE		
		DEFINE	PDT	
			LAC NCP	/LIMIT SET DEFINITION IS COMPLETE
			IDR SETDEF	/WHEN SETDEF EQUALS 34 BASE 8
			DAC SETDEF	
		TERMINATE		
		DEFINE	SBLMNDW	
			JSP FM	
		TERMINATE		
5729	265734	FM,	DAP .+7	
	702200		LAT	
	027600		AND 1237	
5730	265732		DAP .+2	
	073377		ROR 05	
	700000		LAW .-.	
	027321		AND 137	
5734	005734		JMP .	
		BG40,	REPLAY 1,2,0,DATA	
			SBLMNDW	
5744	247140		DAC 'PRES	/SFT PRESENT STATUS
	040110		DZM NCP	
	047141		DZM 'STATUS	
	700001		LAW I	
5750	247142		DAC 'FIRSTX	
	047156		DZM SETDEF	
			REPLAY 1,2,0,THYTEL	
5760	201562		LAC N	
	050100		SZA I	
	006004		JMP G1	
	701000		CMA	
5764	247135		DAC FLIPF	
	207001		LAC I NAME	
	247137		DAC SHH	
	207137	3H4,	LAC SHH	
5770	005773		JMP .+3	
			REPLAY 1,2,NAME	
5777	207137		LAC SHH	
6000	407221		ADD 17	
	247137		DAC SHH	

0002	067135		ISP FLIPF
	005767		JMP 3H4
		G1,	REPLAY 1,2,CHANNEL
		G2,	REPLAY 1,2,0,LSOHC
0021	247140		SBLMNOH
	052000		DAC PRES
	006647		SPI 1
0024	527141		JMP G11
	006424		SAS STATUS
			JMP G10
		OEFINE	TESTA B
			RCR 1S
			SPI
			JMP B
		TERMINATE	
		G3,	PUNCH
0037	200116		LAC NCP
0040	073001		RCR 1S
			IRP A, G6, G7, G8, G9*
		A,	TESTA A
			ENDIRP
		G6,	TESTA G6
		G7,	TESTA G7
		G8,	TESTA G8
		G9	TESTA G9
0059	720127	G4,	OSP
	006060		JMP .+2 /IGNORE THE LIGHT PEN
	720125		DRS /BY RESUMING AFTER A HIT
0060	200122	G31,	LAC XYNDW
	027473		AND 1777
	027603		SUB 1103
	050200		SPA 1
0064	006073		JMP G3B5G
			REPLAY 1,2,0,NAMCRT
0073	201562	G3B5G,	LAC N
0074	050100		SZA 1
	006004		JMP G1 /SKIP IF NO LIMITS
	761000		CMA
	241552		DAC SAVEXX
			SETUP SAVEYY, (LIMITS
0102	006105	G40,	JMP .+3 /SKIP OVER DUMMY AC LOAD
			REPLAY 1,2,LIMITS
0111	041552		ISP SAVEXX
	006114		JMP .+2
	006004		JMP G1
0114	700023		LAW 19.
	001553		ADD SAVEYY
	006102		JMP G40
		G6,	REPLAY 1,1,NAME
0150	207123	G3L,	RESPOND 0,G31,,,,,,,,,,,,,G3L,G4L
	027601		LAC RESP /A NAME
	547177		SUB 1NAME
	567221		MUL 11
			DIV 17

6160	760000		NOP	
	407177	G5L,	AOD (1	
	247143		DAC 'SETODELETE	
6206	606060		NAMECARET SETODELETE	
			JMP G31	
6207	207123	G4L,	LAC RESPP	
6210	427252		SUB 1L1PITS	
	547177		MUL 11	
	567251		OIV (19.	
	760000		NOP	
6214	606161		JMP G5L	
		G7,	POT	
6226	650001		TRACKS	
	606055		SZF 1 1	
			JMP G4	
		G44,	REPLAY 1,2	
6231	720004		TYI	
	760001		CLF 1	
	760200		CLA	
6234	673077		RGR 65	
	507533		SAD 1770000	
	606257		JMP G45	
	663077		RCL 65	
6240	217157		LAC 1 GXG3	
	337157		DIO 1 GXG3	
	661077		RAL 65	
	057157		IDR 1 GXG3	
6244	257157		DAC 1 GXG3	
	467144		ISP 'GXG1	
	606055		JMP G4	
	447157		IDX GXG3	
			ISST GXG1,3	
6252	467145		ISP G'XC2	
	606055		JMP G4	
6254	706272		LAW ENDOFT	
	227215		LIO 15	
	170451		JCA TYPE	
	760001	G45,	CLF 1	
6260	207144		LAC GXG1	
	427177		SUB (1	
	247144		DAC GXG1	
	467144		ISP GXG1	
6264	606266		JMP +2	
	606004		JMP G1	
	217157		LAC 1 GXG3	/WE ARE NOW PUSHING SECOND HALF OF NAME
	661077		RAL 65	/OVER WHEN LESS THAN THREE LETTERS ARE
6270	257157		DAC 1 GXG3	/USED.
	606263		JMP -6	
	222346	ENDOFT,	TEXT /STO	
6273	477700	/	P	

	G8,	ISET 'DWNDRUP,1
	G8T,	PCT
		REPLAY 1,1,TRACE
		RESPOND 0,G31,,,,,,,,,,,,,,,,,G53
0330	227146	G53, LID DWNDRUP
	700012	LAW 10.
	042000	SPI
0340	007613	ADD (-9.
	007252	ADD (LIMITS /-9 IF UPPER IS DN, ELSE LOWER
	247147	DAC G'XG1T
	201562	LAC N
0344	027177	SUB (1
	007251	MUL (19.
	007177	DIV (1
	760000	NDP
0350	007147	ADD GXG1T
	247147	DAC GXG1T
	200122	LAC XYNDW
	027473	AND (777
0354	005001	SAL 15
	247150	DAC GXG'2T
	247135	DAC FLIPF
	217147	LAC I GXG1T
0360	027614	AND (776000
	007150	IDR GXG2T
	257147	DAC I GXG1T
	047147	IDX GXG1T
0364	200122	LAC XYNDW
	004000	CLI
	073777	RCR 95
	061001	RAL 15
0370	247150	DAC GXG2T
	217147	LAC I GXG1T
	027614	AND (776000
	007150	IDR GXG2T
0374	257147	DAC I GXG1T
	227146	LID DWNDRUP
	207135	LAC FLIPF
	042000	SPI
0400	247151	DAC '433H
	052000	SP1 I
	247152	DAC '433L
	207151	LAC 433H
0404	027152	SUB 433L
	247153	DAC 'DELLIM
	227146	LID DWNDRUP
	201562	LAC N
0410	001562	ADD N
	007615	ADD (YXYXL-2
	052000	SP1 I
	007177	ADD (1
0414	247147	DAC GXG1T
	200122	LAC XYNDW

6416	027473	AND (777	
	665001	SAL 15	
6420	257147	DAC I GXGIT	
	606060	JMP G31	
6422	347146	G9,	OZM OWNORUP
	606276		JMP GHT
6424	207141	G10,	LAC STATUS
	067140		XDR PRES
	247154		OAC GXG1'M
6440	207140		PUNCH
	027154		LAC PRES
	247155		AND GXG1M
6445	207154	DAC GXG2'M	/GET STATUS CHANGE
			/0='OFF'
			SETUP STATUS,PRES
			LAC GXG1M
		IRP A,,G70,G71,G72,G73,G74	
		A,,	TESTA A
		ENDIRP	
		G70,	TESTA G70
		G71,	TESTA G71
		G72,	TESTA G72
		G73,	TESTA G73
		G74	TESTA G74
6465	760400		HLT /ERROR HALT
		DEFINE	TESTB A,B
			LAC GXG2M
			SZA
			JMP A
			JMP B
		TERMINATE	
		G70,	TESTB G12,G14 /ON,OFF REDEFINE
		G71,	TESTB G13,G15 / ODELETE
		G72,	TESTB G19,G18 / NAME
		G73,	TESTB G17,G16 / UPPER
		G74,	TESTB G20,G21 / LOWER
6514	340122	G12,	SET REDEFN,1
	606026	G12M,	DZM XYNOW
			JMP G3
6520	606514	G13,	SET NCP,2 /CELETE OFF TO ON
			JMP G12M
6521	340102	G14,	DZM REDEFN /REDEFINE ON TO OFF
	606523		JMP G99
6523	340116	G99,	DZM NCP
6524	606020		JMP G2
6525	201562	G18,	LAC N /NAME ON TO OFF
	605007		SAL 35
	421562		SUB N
6530	407616		ADD (NAME-7
	247144		DAC GXG1
	407177		ADD (1
	247145		OAC GXG2

6534	407177	ADD I1	
	247157	DAC GXG3	
	217145	LAC I GXG2	
	027614	AND I-1777	
6540	057617	IOR I (RPY+10000	
	257145	DAC I GXG2	
	217157	LAC I GXG3	
	027614	AND I-1777	
6544	057620	IOR I (RPX+10000	
	257157	OAC I GXG3	
	207144	LAC GXG1	
	006552	JMP .+3	
		REPLAY 1,2,NAME	
6556	006523	JMP G99	
	006523	G16=G99	/UPPER ON TO OFF
		G21=G99	/LOWER ON TO OFF
		G17,	SET NCP,14 /UPPER OFF TO ON
		SETNAME	
		JMP G3	
6567	006026		
		G20,	SET NCP,20 /LOWER OFF TO ON
		SETNAME	
		JMP G3	
6600	006026		
		G19,	SET NCP,4 /NAME OFF TO ON
		RETRACK	
		SETNAME	
		LAC N	
		SAL 35	
		SUB N	
		CLF 1	
		ADD (NAME+3-7+1	
		DAC *GXG3	
		ISCT GXG2,2	
		ISCT GXG1,3	
		OZM I GXG5	
		LAC GXG3	
		SUB I1	
		OAC GXG3	
		OZM I GXG3	
		JMP G3	
6627	201562		
6630	065007		
	021562		
	760001		
	407627		
6634	247157		
6641	057157		
	207157		
	027177		
6644	247157		
	057157		
	006026		
6647	207156	G11,	LAC SETDEF /LIMITS ON TO OFF
6650	050100	SZA I	
	006657	JMP .+6	/NO CHANGE MADE
	027630	SAS I34	
	006756	JMP G91	/NOT A COMPLETE DEFINITION
6654	207153	LAC *DELLIM	
	040200	SPA	
	006756	JMP G91	/UPPER AND LOWER LIMITS REVERSED
		G94,	SELNDRW /GET SUBLIMIT BUTTON STATUS

6668	440100	SZA		
	406776	JMP G92	/THE SUBLIMIT BUTTONS ARE NOT ALL OFF	
	347153	OZM DELLIM		
6664	347156	OZM SETOEF		
	340122	DZM XYNOW		
	700001	LAW 1		
	247142	OAC FIRSTX		
		REPLAY 1,0,0,NAME		
000027		KKUI=7		
		REPEAT 7,	REPLAY 1,2,0,NAME+KKUI	KKUI=KKUI+7
6758	604716	REPLAY 1,2,0,PTOASL		
		JMP BG40		
		G91,	REPLAY 1,0, LSDNC	
		BG91M,	SBLMNOW	
6769	042000	SPI		
	606004	JMP G1		
		REPLAY 1,0		
6775	606764	JMP BG91M		
		G92,	REPLAY 1,2,PTOASL	
7004	606657	JMP G94		
7009	200122	G15,	LAC XYNOW	
	027473	AND 1777		
	427603	SUB 1103		
7010	640200	SPA		
	606523	JMP G99	/DELETE NULL	
	207143	LAC SETOOELETE		
	427177	SUB 11		
7014	247160	DAC 'WHAREN		
	441007	RAL 35		
	027160	SUB WHAREN		
7020	407601	ADD (NAME		
	247157	DAC GXG3		
	507637	SAD (NAME+7*7		
	407077	JMP G47M		
	407221	ADD 17		
7024	247145	DAC GXG2		
		ISSET GXG1,7		
7027	217145	LAC 1 GXG2		
7030	257157	OAC 1 GXG3		
	447145	IOX GXG2		
	447157	IDX GXG3		
	467144	ISP GXG1		
7034	407027	JMP .-5		
	701572	LAW YXXYL 7777		
	407143	ADD SETODEL		
	407143	ADD SETODEL		
7040	267043	OAP .+3		
	427227	SUB 12		
	267044	OAP .+2		
		LAC .-4		

7043	200000		
7044	240000		
	047043		DAC *-.
	047044		IDX *-2
	107043		IDX *-2
7050	107044		XCT *-4
	207143		XCT *-4
	027177		LAC SETDDEL
	061017		SUB (1
			RAL 45
	007252		REPEAT 3, ADD WHAREN
7060	247157		ADD (LIMITS
	507543		DAC GXG3
	007077		SAD (LIMITS+19.*7
	007251		JMP G47M
7064	247145		ADD (19.
			DAC GXG2
			ISET GXG1,19.
7071	047145	G47,	SETUP 1 GXG3,1 GXG2
	047157		IDX GXG2
	067144		IDX GXG3
7074	007067		ISP GXG1
	047143		JMP G47
	007012		IDX SETDDEL
			JMP G47K
7077	201562		
7100	027177	G47M,	LAC N
	241562		SUB (1
			DAC N
			REPLAY 1,2,0,NAMCRT
7110	006523		JMP G99

EQUALS TAPSPC,NULL
 EQUALS TAPRED,NULL
 EQUALS REWIND,NULL
 EQUALS RESPOND,NULL
 EQUALS BUTEST,NULL
 EQUALS SBIMNDW,NULL
 EQUALS SETNAME,NULL
 EQUALS PDT,NULL
 EQUALS TESTB,NULL

ENDDFMODULE

START


```

BASELINE 4
10000 10000/

/JMP RESET TO RESET TABLE VALUES SINCE HAVE
/ENCOUNTERED ONE THAT IS TOO LARGE

EQUALS REPLAY, NULL

DEFINE REPLAY A, R
JSP I (RPLCA)

TERMINATE

RESET, LAC I (GRANULE
ACD I (GRANULE
AND (777
FOR (675000
DAC I (GRANULE /INCREASE SHIFT INSTRUCTION BY ONE

10009 211533 LAC I COUNTER /X VALUE
050200 SRA I
000013 JMR -+4
10010 004414 ACD (1
050100 SZA (
000015 JMR -+3
114411 XCT I (GRANULE /SHIFT INSTRUCTION
10014 040200 SPA
044414 SUB (1
040200 SRA
761000 CMA
10020 404414 ACD (1
240605 DAC TTT /ABSOLUTE VALUE + (

10022 204415 LAC (ZLOC
240046 DAC ADR1
10024 424416 SUB (2
240040 DAC ADR2

10026 204415 LAC (ZLOC
424417 SUB (4
10030 240607 DAC TP1
404420 ACD (6
240610 DAC TR2

10033 220607 ML, LIO TRI /TO MOVE EVERYTHING IN THE
10034 200607 LAC TP1 /IALLY TABLE DOWN
004416 ACD (2
OPR DACC

10040 777777 ADR2, -.-
220610 LIO TP2
200610 LAC TR2
424416 SUB (2
OPR DACC

10046 777777 ADR1, -.-

```

10047	200607		LAC TP1
10050	424417		SUB I4
	824428		SUB ITABLE
	840200		SPA
	000072		JMP TH
10054	404423		ADD ITABLE
	240607		DAC TP1
	200610		LAC TP2
	004417		ACD I4
10060	240610		DAC TP2
	824424		SUB I MAXIMUM
	840400		SMA
	000072		JMP TH
10064	710002		LAW I 2
	400040		ADD ADR2
	240040		DAC ADR2
	840046		ICX ADR1
10070	840046		IDX ADR1
	000033		JMP ML
10072	200605	TH,	LAC TTT
	005001		SAL IS
10074	004415		ADD IZLDC
	240606		DAC TT
	824424		SUB IZLDC+915.
	840400		SMA
10100	000000		JMP RESET
	850606	RZERO,	DZM I TT /CLEAR UNUSED PART OF TALLY TABLE
	440406		IDX TT
	824424		SAS IZLDC+915.
10104	000101		JMP RZERO
	200605		LAC TTT
	005001		SAL IS
	001000		CMA
10110	004415		ADD IZLDC
	240605		DAC TTT
	204423		LAC ITABLE
10114	244355		DAC T'AX
	054355	RRZERO,	DZM I TAX
	044355		IDX TAX
	520605		SAS TTT
	000114		JMP RRZERO /HAVE CLEARED UNUSED PART OF TALLY TABLE
10120	014425		JMP I ILDDP1 /RETURN
/JSP SUM'. MU + X IN 'SUMPOS' , MU - X IS 'SUMNEG',			
/SUM INCLUDES BOX HIT ', CUMSUM = SUMPOS+SUMNEG			
10122	244356	SUM	DAC 'XFINI /EXTENDED PROGRAM COUNTER
	254426		LID I IXYNDW /XY COORDINATE OF POINT SEEN
	060200		CLA
10124	003777		RCL 95

10129	661001	RAL 15	
	240605	DAC TTT	/JUST X COORDINATE
	700001	LAW 1	
10130	240611	DAC ONE	
	340612	DZM SUMNEG	/INITIALIZE TO ZERO
	340614	DZM SUMPOS	/INITIALIZE TO ZERO
	340616	DZM CUMSUM	/INITIALIZE TO ZERO
10134	340613	DZM SUMNEG+1	
	340615	DZM SUMPOS+1	
	340617	OZM CUMSUM+1	
10137	200611	REPT, LAC ONE	
10140	544427	MUL (1000.	
	574430	DIV 1 (DX	/COORDINATE OF THE STEP
	760000	NOP	
	414431	ADD 1 (SAVEX	/SINCE IN MODULE 0
10144	420605	SUB TTT	
	640400	SMA	/TEST IF IN THIS STEP
	600152	JMP FIGURE	/YES-GO FIND STEP FOR MU
	440611	IDX ONE	/NO-GO ON TO NEXT STEP
		REPLAY 1,2	/KEEP DISPLAY GOING
10151	600137	JMP REPT	
10152	214433	FIGURE, LAC 1 (MU	/MU TIMES 1000.
	644414	MUL (1	/SET UP FOR DIVISION
10154	564427	OIV (1000.	
	760000	NOP	
	650200	SPA 1	
	600163	JMP .+4	
10160	404414	ACD (1	
	650100	SZA 1	
	600165	JMP .+3	
	114411	XCT 1 (GRANULE	
10164	640200	SPA	
	424414	SUB (1	
	665001	SAL 15	
	404415	ADD (ZLOC	
10170	240606	DAC TT	/ADDRESS OF TALLY WITH MU
	404416	ADD (2	
	244357	OAC 'REG2W	
	214434	LAC 1 (TEMP	
10174	420611	SUB ONE	/STEP NO. POINT IS IN
	404414	ADD (1	
	761000	CMA	
	665001	SAL 15	/SINCE DOUBLE PRECISION
10200	404415	ADD (ZLOC	
	240605	DAC TTT	/ADDRESS OF TALLY WITH POINT
	244360	DAC 'REG1W	
10203	200606	LAC TT	/ADDRESS OF TALLY WITH MU
10204	420605	SUB TTT	/ADDRESS OF TALLY WITH POINT
	640400	SMA	
	600212	JMP REG1	
	400606	ADD TT	
10210	240605	OAC TTT	/DO NEGATIVE SIDE FIRST
	244360	DAC 'REG1W	

```

10213 204360
10214 224435

10217 010612
10220 200606
        520605
        000232
        200612
10224 240614
        240616
        200613
        240615
10230 240617
        000307
        204360
        404416
10234 244360
        520606
        000212

10237 224360
10240 002001
        444360
        204360
        077001
10244 240621
        067777
        067377
        240620
10250 204436
        224435

10254 010612
        200606
        020605
        000606
10260 404416
        244361

10262 200620
        240614
10264 200621
        240615

10267 204357
10270 224437

10273 010614
10274 204357
        404416
        244357
        424361

```

```

REG1,  REPLAY 1,2      /KEEP DISPLAY GOING
        LAC REG1W
        LID (SUMNEG+10000
        DPR DADD        /DOUBLE PRECISION ADD
        SUMNEG+10000
        LAC TT
        SAS TTT
        JMP A+B.
        LAC SUMNEG
        DAC SUMPDS
        DAC CUMSUM
        LAC SUMNEG+1
        DAC SUMPDS+1
        DAC CUMSUM+1
        JMP FIN1
        LAC REG1W
        ADD I2
        DAC REG1W
        SAS TT          /TEST IF HAVE GOTTEN TO MU
        JMP REG1        /NO-CONTINUE

        LID REG1W
        RIL 15
        IDX REG1W
        LAC REG1W
        SCR 15          /WANT ONLY HALF
        DAC HALF+1
        SCL 95
        SCL 85
        DAC HALF
        LAC (HALF+10000
        LID (SUMNEG+10000
        DPR DADD
        SUMNEG+10000
        LAC TT
        SUB TTT
        ACD TT
        ACD I2
        DAC *4T4T

        LAC HALF
        DAC SUMPDS
        LAC HALF+1
        DAC SUMPDS+1

REG2,  REPLAY 1,2      /KEEP DISPLAY GOING
        LAC REG2W
        LID (SUMPOS+10000
        DPR DADD
        SUMPDS+10000
        LAC REG2W
        ADD I2
        DAC REG2W
        SUB 4T4T

```

10300	040200 600266	SPA JMP REG2
10302	204437 224435	LAC (SUMPDS+10000 LIO (SUMNEG+10000 DPR DADD CUMSUM+10000
10306	010616	
10307	014356	FINI, JMP 1 XFINI

/EXPONENTIAL, SQ. RT., AND TABTEST SLORS

/SUBROUTINE TO CALCULATE (E TO THE (-X) POWER * 1/(SIGMA * SQ. RT. (2 * PI) * 1
/X IS 1000.X AND SIGMA IS SIGMA * 1000.
/ENTRY IS JAD EXP WITH X IN THE AC
/RETURNS WITH ANSW. 1000 IN AC

10310	777777 244362 214440 244363	EXP *- DAC *EXPXX LAC 1 (SIGMA DAC *SIGTEM LAW 10. MUL (39894. DIV SIGTEM LAC (79788. DAC SIGTEM
10314	700012 644441 664363 204442	/1/SQ. RT. 2 PI X100,000 /TREAT SIGMA = 0 AS SIGMA = .0005 /RESULT IS X1000.
10320	244363	REPLAY 1,2 /KEEP DISPLAY GOING
10322	214443 434433	LAC 1 (EXP SUB 1 (MU DAC 1 (EXP MUL 1 (EXP DIV 1 (SIGMA LAC (100000. DAC 1 (EXP MUL (1. DIV 1 (SIGMA LAC (100000. SAR 15 SUB (12. SMA-SZA JMP EXPW
10324	254443 654443 574440 204444 254443	/ERRDR IN DIVISION /ERRDR IN DIVISION /IF X 12, THEN ANSWER IS ZERO /RESULT =0
10330	544414 574440 204444	
10334	075001 424445 040500 000422	
10340	214443 544427 574440 204444	LAC ((EXP MUL (1000. DIV 1 (SIGMA LAC (100000. SAR 15 DAC 1 (EXP MUL (2507. DIV (10000. NDP ADD (1000.
10344	075001 254443 644446 664447	/RESULT IS TIMES 1000. /X
10350	760000 404427	


```

10352 244364
      214443
10354 654443
      664427
      760200
      644450
10360 564444
      760000
      404364
      244364

```

```

DAC *EXPTM
LAC I (EXP
MUL I (EXP
DIV (1000.
CLA
MUL (2927.
DIV (100000.
NOP
ADD EXPTM
DAC EXPTM

```

REPLAY I,2 /KEEP DISPLAY GOING

```

10368 214443
      654443
      664427
10370 760200
      654443
      664427
      760200
10374 644451
      664444
      760200
      404364
10400 644364
      664427
      760200
      544364
10404 664427
      760200
      544364
      664427
10410 760200
      244364
10412 204447
      644427
10414 564364
      760200
      544363
      664447
10420 760200
      414362
      760200
      600421

```

```

LAC I (EXP
MUL I (EXP
DIV (1000.
CLA
MUL I (EXP
DIV (1000.
CLA
MUL (383.
DIV (100000.
CLA
ADD EXPTM
MUL EXPTM
DIV (1000.
CLA
MUL EXPTM
DIV (1000.
CLA
MUL EXPTM
DIV (1000.
CLA
DAC EXPTM

```

```

EXPX,
EXPW,
      JMP I EXPXX
      CLA
      JMP EXPX

```

/E RAISED TO THE MINUS X POWER COMPUTED WITH
 /APPROXIMATION FORMULA FROM 'APPROXIMATIONS FOR
 /DIGITAL COMPUTERS' BY HASTINGS
 /THE FORMULA IS $\frac{1}{1+A(1)X+A(2)X^2+A(3)X^3}$ TO THE 4TH
 /WHERE A(1) = .2507,213, A(2) = .0292,732, A(3) = .0038,278
 /WITH AN ERROR OF ± 0.0002 AND USUALLY BETTER

```

/*JDA SQRT* TO GET SQUART ROOT

10424 777777
244365
710024
245226
10430 200424
675001
254440
760200
10434 220424
667003
574440
760000
10440 677001
642000
404414
814440
10444 675001
434440
650100
600455
10450 814440
254440

10453 865226
10454 600433
614365

SQR1 *-
DAC *PCX /GETS VARIANCE
LAW 1 20. /EXTENDED PROGRAM COUNTER
DAC MAC
LAC SQRT 7777
SAR 15 /DIVIDE BY TWO
OAC 1 (SIGMA /1ST ARBITRARY APPROXIMATION
CLA
L10 SQRT 7777
SCL 25 /TO CORRECT SIGN AND MUL. BY 2
DIV 1 (SIGMA
NGP
SCR 15
SPI /TEST IF NEED TO ROUND
ADD 1 /YES INCREMENT ANSWER BY 1
ADD 1 (SIGMA /APPROX. SQ. RT. BY
SAR 15 /((Y/AIN) + AIN)/2
SUB 1 (SIGMA
SZA 1 /TEST IF PREVIOUS APPROX IS SAME
JMP PC /YES - DONE
ADD 1 (SIGMA /NO-FIND BETTER APPROX.
DAC 1 (SIGMA /NEW AIN)

REPLAY 1,2 /KEEP DISPLAY GOING
TSP MAC
JMP CONT
PC, JMP 1 PCX /LEAVE

/*JSP TABTEST* TO FIND THE NUMBER OF STEPS AND MAXIMUM Y VALUE

10456 244366
700622
10460 260461
200622
804452
640100
10464 600467
440461
600461

10470 704267
260472

10472 204267
804452
10474 640100
600502
710001
400472
10500 240472

TABTEST LAC *DINDEX /EXTENDED PROGRAM COUNTER
DAP .+1
TESTNEG, LAC TABLE 7777
ADD 10 /TO FIND 1ST INDEXED VALUE
SZA
JMP TEST1
ICX TESTNEG
JMP TESTNEG

TEST1, REPLAY 1,2 /KEEP DISPLAY GOING
LAW ZLOC 7777+914.
OAP .+1

TESTPOS, LAC ZLOC 7777+914. /STARTING AT OTHER END
ADD 10
SZA /TABLE, DO THE SAME AS ABOVE
JMP COMPI
LAW 1 1
ADD TESTPOS
OAC TESTPOS

```

10502	000472	JMP TESTPDS	
		CDMP1,	REPLAY 1,2 /KEEP DISPLAY GOING
10503	200461		
10504	024453	COMPARE,	LAC TESTNEG
	024454		
	077001	AND (7777	
	052000	SUB (ZLOC 7777	
10510	024414	SCR 15	/SINCE HAVE DOUBLE PRECISION
	040200	SPI 1	
	701000	SUB (1	
	254434	SPA	
		CMA	
		DAC ((TEMP	/ABSOLUTE VALUE
10514	200472	LAC TESTPDS	
	024453	AND (7777	
	024454	SUB (ZLOC 7777	
	077001	SCR 15	/SINCE HAVE DOUBLE PRECISION
10520	040200	SPA	
	701000	CMA	
	034434	SUB 1 (TEMP	
	040200	SPA	
10524	000527	JMP .+3	
	014434	ADD 1 (TEMP	
	254434	DAC 1 (TEMP	
	214434	LAC 1 (TEMP	
10530	024453	AND (7777	
	065001	SAL 15	
	004414	ADD (1	
	701000	CMA	
10534	254455	DAC 1 (COUNTER	/NUMBER OF STEPS
		REPLAY 1,2	/KEEP DISPLAY GOING
10536	202445	LAC ZLOC 7777	/LDW ORDER PART
	254424	DAC 1 (MAXIMUM	/1ST ESTIMATE TO MAX. VALUE
10540	202446	LAC ZLOC 7777+1	/HIGH ORDER PART
	254456	DAC 1 (MAXIMUM+1	/BDTH DDUBLE PRECISION
10542	214434	LAC 1 (TEMP	
	024453	AND (7777	
10544	065001	SAL 15	/SINCE DOUBLE PRECISION
	701000	CMA	
	004454	ADD (ZLOC 7777	
	200552	DAP ADDRESS	
		REPLAY 1,2	/KEEP DISPLAY GOING
10550	214424	LAC 1 (MAXIMUM	
	020552	SUB ..	/DIFFERENCE DF LDW ORDER PARTS
	040400	SMA	/TEST IF NEED TO BORROW
10554	000560	JMP .+4	/ND, JUMP AHEAD
	710001	LAW 1 1	/YES DD SD
	014456	ADD 1 (MAXIMUM+1	
	254456	DAC 1 (MAXIMUM+1	

10560	040552	ICX ADDRESS	
	214456	LAC 1 (MAXIMUM+1	
	720074	LEM	
	430552	SUB 1 ADDRESS	/DIFFERENCE OF HIGH ORDER PARTS
10564	724074	EEM	
	040200	SPA	/TEST WHICH IS LARGER
	000573	JMP CHANGE	/PUT Y INTO MAX. SINCE IS LARGER
10567	040552	BACK,	ICX ADDRESS /MAX. LARGER, LEAVE AS IS
10570	074455	ISP 1 (COUNTER	/TEST IF HAVE DONE EACH REGISTER
	000550	JMP TTEST	/NO-CONTINUE TESTING
10572	014366	DONE,	JMP 1 DONEX /YES-LEAVE
10573	720074	CHANGE,	LEM
10574	210552		LAC 1 ADDRESS /HIGH ORDER PART OF NEW Y MAX
	724074		EEM
	254456		OAC 1 (MAXIMUM+1
	710001		LAW 1 1
10600	040552		ADD ADDRESS
	260602		DAP ++1
	200602		LAC --
	254424		OAC 1 (MAX)MUM
10604	000567		JMP BACK /GO BACK AND FINISH TESTING
/CONSTANTS			
10605	777777	TTT,	--
	777777	TI,	--
	777777	TP1,	--
10610	777777	TP2,	--
	000001	CNE,	1
	777777	SUMNEG,	--
	777777		--
10614	777777	SUMPOS,	--
	777777		--
	777777	CUMSUM,	--
	777777		--
10620	777777	HALF,	--
	777777		--
	777777	TABLE	--
12445		TABLE+915./	--
12445	777777	ZLOC	--
14270		ZLOC+915./	--
14270	777777	MAXIMUM	--
	777777	MAXIMUM+1	--
/LIGHT PEN FOLLOW ROUTINE			
	010000	MM1=10000	
	710000	LAM=LAW 1	
14272	244564	LPFOLL,	OAC PFX1T /SET EXIT

14273	344367	DZM *LPSWCH	/ZERO SWITCH FOR TEST
14274	204565	LAC INTEN	
	044566	IDR WRPRAM	/030110 - DISABLE L.P.
	244610	DAC LBUFF	/PAR PT
	204567	LAC WPY	/WRITING PDINT
14300	044601	ICR WPYWD	/PT PT
	244611	DAC LBUFF+1	
	204570	LAC WPX	/WRITING POINT
	044602	ICR WPXWD	/PT PT
14304	244612	DAC LBUFF+2	
	204571	LAC RPY	/REFERENCE PDINT
	044601	IDR WPYWD	/PT PT
	244613	DAC LBUFF+3	
14310	204572	LAC RPX	/REFERENCE PDINT
	044603	IDR CPXWD	/PT PAR.
	244614	DAC LBUFF+4	
	204565	LAC INTEN	
14314	044604	ICR PARAM	/ENABLE L.P.
	244615	DAC LBUFF+5	
	204571	LAC RPY	
	044605	ACD (-33)	
14320	024460	AND (1777)	
	244573	DAC YPT	/CENTER Y
	044601	IDR WPYWD	
	244616	DAC LBUFF+6	
14324	204572	LAC RPX	
	044601	ACD (33)	
	244574	DAC XPT	/CENTER X
	044603	ICR CPXWD	/PT PAR
14330	244617	DAC LBUFF+7	
	204602	LAC (3000)	
	244620	DAC LBUFF+10	/SIDP
	204603	LAC (JMP I PFXIT)	
14334	244561	DAC STPCDC	
	204604	LAC (JMP TRACK)	
	244563	DAC LPHIT	
	224465	LID (MMI LBUFF)	
14340	624543	JSP RTDUT	
	760400	HLT	
		/LIGHT PEN TRACK FDR PDP1	
14342	204565	LAC INTEN	
	044566	ICR WRPRAM	
14344	244612	DAC LBUFF+2	
	204573	LAC YPT	/CENTER Y
	044601	ICR WPYWD	
	244616	DAC LBUFF+6	
14350	204574	LAC XPT	/CENTER X
	044606	ACD (47)	/X + INCR.
	024600	SUB WRXR	
	640400	SMA	/IS IT OUT OF BDX
14354	604530	JMP RTX	/YES SET MAX.
	204574	LAC XPT	/NO
	044606	ACD (47)	

14357	044605	TRACK1,	IOR CPWD	/PT	VECTDR
14360	244617		OAC LBUFF+7		
	204467		LAC (600277)	/I	VECTOR IN (-X)
	244620		OAC LBUFF+10		
	204462		LAC (3000)		
14364	244621		DAC LBUFF+11		
	204470		LAC (JMP RTRXIT)		
	244563		OAC LPHIT	/SET	EXIT
	204367		LAC LPSWCH		
14370	040100		SZA	/HAS	Y BEEN FOUND YET
	004374		JMP .+3	/YES	
	204471		LAC (JMP MODSW)	/NO	
	004375		JMP .+2		
14374	204472		LAC (JMP LPFOLL+1)		
	244561		DAC STPCOD		
	244556		DAC EDGHIT		
	224473		LID (MM1 LBUFF+2)		
14400	024543		JSP RTROUT	/DISPLAY	
	720126		DKC	/X-Y	I.D.
	003777		RCL 95		
	003001		RCL 15	/X	0-16
14404	024474		AND (1776		
	244606		DAC X1	/X	ONLY
	204574		LAC XPT		
	404475		ADD (-50)		
14410	024577		SUB WRXL		
	040200		SPA	/IS	IT OUT OF RDX
	004532		JMP LFTX	/YES	
	204574		LAC XPT	/NO	
14414	404475		ADD (-50)		
	044605	TRACK2,	IOR CPWD		
	244617		DAC LBUFF+7		
	204476		LAC (600077)	/I	VECTOR IN (+X)
14420	244620		DAC LBUFF+10		
	224473		LIO (MM1 LBUFF+2)		
	024543		JSP RTROUT	/DISPLAY	
	720126		ORC	/X-Y	I.D.
14424	003777		RCL 95		
	003001		RCL 15		
	024474		AND (1776	/X	ONLY
	404606		ADD X1		
14430	075001		SAR 15	/FINO	MFAN
	244574		DAC XPT		
	404457		ADD (-33)		
	244572		DAC RPX		
14434	204367		LAC LPSWCH		
	040100		SZA	/Y	FOUND \$
	014964		JMP I PFXIT	/YES	
	204572	GETY,	LAC RPX	/NEW	REFERENCE IN X
14440	044603		IOR CPXWO		
	244614		DAC LBUFF+4		
	204574		LAC XPT	/NEW	CENTER X
	044605		IOR CPWO		
14444	244617		DAC LBUFF+7		

14445	204573		LAC YPT	/CENTER Y
	404466		ACD (47)	
	424576		SUB WRYT	
14450	604020		SMA	/IS IT OUT OF BOX
	604537		JMP UPY	/YES
	204573		LAC YPT	/NO
	404466		ADD (47)	
14454	604460	TRACK4,	IOR WPYWD	
	244616		DAC LBUFF+6	
	204477		LAC (737400)	/VECTOR IN (-Y)
	244620		OAC LBUFF+10	
14460	204472		LAC (JMP LPFOLL+1)	
	244561		OAC STPCOD	
	244556		DAC EDGHIT	/SET EXITS
	224473		LID (MM1 LBUFF+2)	
14464	624543		JSP RTROUT	
	720126		DRC	/X - Y I.D.
	673777		RCR 95	
	673377		RCR 85	
14470	624474		AND (17761	/Y IN 8 L6
	244607		DAC Y1	
	204573		LAC YPT	
	404475		ADD (-50)	
14474	424575		SUB WRYB	
	604020		SPA	/IS IT OUT OF BOX
	604541		JMP DOWNY	/YES
	204573		LAC YPT	/NO
14500	404475		ADD (-50)	
	604460	TRACK3,	IOR WPYWD	
	244616		DAC LBUFF+6	
	204500		LAC (637400)	/1 VECTOR IN + Y
14504	244620		OAC LBUFF+10	
	224473		LID (MM1 LBUFF+2)	
	624543		JSP RTROUT	/DISPLAY
	720126		DRC	/X - Y I.D.
14510	673777		RCR 95	
	673377		RCR 85	
	624474		AND (17761	/Y IN 8 - 16
	404460		ADD Y1	
14514	675001		SAR 15	/FIND MEAN
	244573		DAC YPT	/NEW CENTER Y
	404461		ADD (33)	
	244571		DAC RPY	
14520	604460		IOR WPYWD	
	244613		DAC LBUFF+3	
	204367		LAC LPSWCH	
	604400		SPA	/BOTH X + Y FOUND \$
14524	614564		JMP I PFXIT	/YES
	700001		LAW 1	/NO - LOOK FOR X
	244367		DAC LPSWCH	
	604342		JMP TRACK	
14530	204600	RTX,	LAC WRXR	/EDGE OF BOX - RIGHT
	604357		JMP TRACK1	
	204577	LFTX,	LAC WRXL	/EDGE OF BOX - LEFT

14533	004415	JMP TRACK2	
14534	710001	LAM 1	/CAN'T FIND X
	244367	OAC LPSWCH	
	004437	JMP CFTY	
	204576	LAC WRYT	/EDGE OF RCX - TOP
14540	004454	JMP TRACK4	
	204575	LAC WRYB	/EDGE OF BOX - BOTTOM
	004501	JMP TRACK3	
	264557	DAP RTRXIT	/SET EXIT
14544	720025	OLA	/START DISPLAY
	720227	OSS	/STOP \$
	004550	JMP .+2	/NO
	004560	JMP STPCOC-1	/YES
14550	720127	OSP	/L.P. HIT
	004553	JMP .+2	/NO
	004562	JMP LPHIT-1	/YES
	721427	OSE	/EDGE HIT
14554	004545	JMP .-7	/NO RECYCLE
	760000	NOP	
	000000	NOP	
	004557	EOGHIT,	/EDGE EXIT
	004557	RTRXIT,	JMP .
14560	760000	NOP	
	000000	STPCOC,	/STOP EXIT
	720125	ORS	
	000000	LPHIT,	/L.P. EXIT
14564	000000	PFXIT,	
	000007	INTEN,	7
	030110	WRPRAM,	030110
	001033	WPY,	1033
14570	001033	WPX,	1033
	001033	RPY,	1033
	001033	RPX,	1033
	001000	YPT,	1000
14574	001000	XPT,	1000
	000000	WRYB,	0
	001777	WRYT,	1777
	000000	WRXL,	0
14600	001777	WRXR,	1777
	220000	WPYWD,	220000
	022000	WPXWD,	022000
	002000	CPXWD,	002000
14604	034110	PARAM,	34110
	102000	CPWD,	102000
	000000	X1,	0
	000000	Y1,	0
14610	000000	LBUFF,	0
14630		LBUFF+20*MODULE/	START

/BASELINE 5

```

/DAD
/ LID TREG. NO.
/ LAC ADDRESS DF 2 REGISTER NUMBER ISX
/ JDA DAD /PUTS SUM IN ADDRESS IN AC
/
/JDA CADD'.
/ LID ADDRESS DF 2REG. NO.
/ LAC LDW ORDER ADDRESS DF 2 REG.
/ JDA DADD
/ ADDRESS
/RETURN
/
/JDA DDAD'.
/ LAC LDW ORDER ADDRESS DF 4 REG. NO.
/ LID LDW ORDER ADDRESS OF 4 REG. NO.
/ JDA DDAD
/ RETURN /ANSWER IN ADDRESS IN AC
/
/JDA DINDEX'.
/ LAC ADDRESS DF LDW ORDER PT. OF 2 REG. NO.
/ JDA DINDEX
/
/JDA DPCIV'.
/ LAC ADDRESS DF LDW ORDER PART DF NUM. 12R)
/ LID ADDRESS DF LDW ORDER PART DF DEN 12R)
/ JDA DPCIV
/ RETURN /ANSWER IN AC + 10, SIGN=BIT0 IN BDTH
/
/JDA DMUL'.
/ LAC ADDRESS DF LDW ORDER PART OF 2 REG. NUMBER
/ LID ADDRESS DF LDW ORDER PART DF 2 REG. NUMBER
/ JDA DMUL
/ ADDRESS DF 4 REG. NO. WHERE TO PUT ANSWER
/ RETURN
/
/JDA DPCIV4'.
/ LAC ADDRESS OF LDW ORDER PART OF 4 REG. NUMERATOR
/ LID ADDRESS DF LDW ORDER PART DF 2 REG. DENOMINATOR
/ JDA DPCIV4
/ ADDRESS DF 4 REG. NO. TO PUT ANSWER IN
/ RETURN
/
/JDA DPCIVF'.
/ LAC ADDRESS DF LDW ORDER PART DF 4 REG. NUMERATOR
/ LID ADDRESS DF LDW ORDER PART DF 4 REG. DENOMINATOR
/ JDA DPCIVF
/ RETURN /ANSWER IN AC - WILL BE ONLY 1 REG.

```

```

14620 77777
14624
14640 77777
77777
77777
004642
14643 244370
14644 324641

```

```

DMAC,      "-.
DMAC+4+MDDULE/
DMZEDR,    REPEAT 4, 0
DMULAN,    "-.
DMULI,     "-.
DMUL       "-.
           QDMUL=DMUL 7777
           DAC *DMULXX
           DID DMULI

```

	214370	LAC I DMULXX
	244640	DAC DMULAN
	444370	ICX DMULXX
14650	344634	DZM DMZERO
	344635	DZM DMZERO+1
	344636	DZM DMZERO+2
	344637	DZM DMZERO+3
14654	214642	LAC I QDMUL
	654641	MUL I DMUL1
	672001	RIR 1S
	244631	DAC DMAC+1
14660	324630	DID DMAC
	344632	DZM DMAC+2
	344633	DZM DMAC+3
		REPLAY 1,2 /KEEP DISPLAY GOING
14664	204501	LAC (DMAC+10000
	224502	LID (DMZERO+10000
		DPR DDAD
14670	214642	LAC I QDMUL
	244631	DAC 'XYZQW /SAVE
	444642	ICX QDMUL
	214642	LAC I QDMUL
14674	654641	MUL I DMUL1
	672001	RIR 1S
	244636	DAC DMZERO+2
	324635	DID DMZERO+1
14700	204501	LAC (DMAC 10000
	224502	LID (DMZERO+10000
		DPR DDAD
14704	444641	ICX DMUL1

14705	214641		LAC I DMUL1
	844371		MUL XYZQW
	672001		RIR IS
14710	244636		DAC DMZRD+2
	324635		DID DMZRD+1
	204501		LAC (DMAC 10000
	224502		LID (DMZRD+10000
			DPR DDAC
			REPLAY 1,2 /KEEP DISPLAY GOING
14717	214642		LAC I QDMUL
14720	854641		MUL I DMUL1
	672001		RIR IS
	344635		DZM DMZRD+1
	244637		DAC DMZRD+3
14724	324636		DID DMZRD+2
	204501		LAC (DMAC+10000
	224502		LID (DMZRD+10000
			DPR DDAD
			IRP GG,,0,1,2,3#
		GG,,	LAC DMAC+GG
			DAC I DMULAN
			ICX DMULAN
			ENDIRP
14731	204630		LAC DMAC+2
	254640		DAC I DMULAN
	444640		ICX DMULAN
14734	204631		1,
	254640		DAC I DMULAN
	444640		ICX DMULAN
14740	204632		2,
	254640		DAC I DMULAN
	444640		ICX DMULAN
	204633		3
	254640		DAC I DMULAN
14744	444640		ICX DMULAN
	614370		DMULX,
			JMP I DMULXX
14746	777777		DDADL,
	777777		DDAD
	004747		DDADL,
14750	244372		DDAD
	324746		DDAD=DDAD 7777
	204747		DAC DDADXX
	244756		DID DDADL
			LAC DDAD
			DAC ++3
			DPR DADD
14756	777777		DDADL,
	651000		DDAD
14760	404775		SZD I
	404000		JMP DDADX
	404770		SMA
	444747		JMP ++6
14764	204505		ICX DDAD
	034747		LAC (377777
	254747		AND I DDAD
	005160		DAC I DDAD
14770	444747		JMP DADCX+1
	214747		ICX DDAD
	044506		LAC I DDAD
	254747		ICR (400000
14774	005160		DAC I DDAD
			JMP DADCX+1

	044747	DDADX,	IDX QDAD	
14777	044746		REPLAY 1,2	/KEEP DISPLAY GOING
15000	044746		ICX DDADL	
	224746		ICX DDADL	
	044747		LID DDADL	
	245006		ICX QDAD	
			DAC .+3	
15000	777777		DPR DACC	
	014372		*~*	
			JMP I DDADXX	

15010	777777	DAX,	---	
	777777	DAD	---	
	005011		QDAD=DAD 7777	
15012	244373		DAC *DADXX	
	825010		DID DAX	
15014	215011		LAC I QDAD	
	051600		CLO	
	005010		ACD DAX	
	041000		SZD	
15020	005063		JMP DADX+1	
	255011		DAC I QDAD	
	244374		DAC DAD*WM	
	045011		IDX QDAD	
15024	204374		LAC DADWM	
	075011		XDR I QDAD	
	040400		SMA	
	005062		JMP DADX	
15030	215011		LAC I QDAD	
	004452		ADD (P	
	050100		SZA I	
	005062		JMP DADX	
15034	040400		SMA	
	005050		JMP DADBB	
	004414		ACD (I	
	255011		DAC I QDAD	
15040	205011		LAC QDAD	
	024414		SUB (I	
	245011		DAC QDAD	
	215011		LAC I QDAD	
15044	004506		ADD (400000	
	024414		SUB (I	
	255011		DAC I QDAD	
	005062		JMP DADX	
15050	024414	DADBB,	SUB (I	
	255011		DAC I QDAD	
	205011		LAC QDAD	
	024414		SUB (I	
15054	245011		DAC QDAD	
	215011		LAC I QDAD	
	004505		ADD (377777	
	004414		ADD (I	
15060	255011		DAC I QDAD	
	005062		JMP DADX	
	014373	DADX,	JMP I DADXX	
	040200		SPA	
15064	005075		JMP DACJ	
	004506		IDR (400000	
	255011		DAC I QDAD	
	045011		IDX QDAD	
			REPLAY 1,2	/KEEP DISPLAY GOING
15071	710001		LAW I 1	
	015011	DADP,	ADD I QDAD	
	255011		DAC I QDAD	
15074	005062		JMP DADX	
	024505	DADJ,	AND (377777	
	255011		DAC I QDAD	
	045011		IDX QDAD	
15100	700001		LAW I	
	005072		JMP DADM	

15102	777777	DINDEX	•-•	/LOCATION OF LOW ORDER PART
005102			QCINDEX=DINDEX 7777	
15103	244375		DAC 'DINDEX	
15104	651600		CLD	
	700001		LAW 1	
	415102		ACC 1 QCINDEX	/INDEX DOUBLE PRECISION
	024505		AND (377777	
15110	255102		DAC 1 QCINDEX	/REGISTER BY ONE
	445102		IDX QCINDEX	
	441000		SZD	
	455102		IDX 1 QCINDEX	
15114	414375	DINDEX,	JMP 1 DINDEX	
	777777	DADCL,	•-•	
	777777	DADDM,	•-•	
	777777	DAOD	•-•	/LOCATION OF LOW ORDER PART OF A
005117			QDADD=DACC 7777	
15120	244376		DAC 'QADDPX	/IO HAS LOCATION OF LOW ORDER MOST OF B
	204507		LAC (LAW 1	
	245150		DAC DADDP	
	214376		LAC 1 QADDPX	
15124	245115		DAC DADCL	/ANSWER PUT IN ARG FOLLOWING JDA
	651600		CLD	
	700006		CLF 6	
	444376		ICX DACCXX	
15130	325116		DID DADDM	
	215117		LAC 1 QOAOO	
	415116		ADD 1 DADDM	
	451000		SZD 1	
15134	405141		JMP DADDM	
	700016		STF 6	
	440400		SMA	

15132	005160		JMP DADDB	
15140	024505		AND (377777	
	255115	DADDW,	DAC I DADDL	
	244377		DAC DAD'FWM	
	445115		IDX DADDL	
15144	054421		IDX I (DADD	
	445116		IDX DADDM	
	700200		CLA	
	040000		SZF 6	
15150	700001	DADDP,	LAW I	
	415117		ADD I QDADD	
	415116		ADD I DADDM	
	255115		DAC I DADDL	
15154	044377		XDR DAD'FWM	
	040200		SPA	
	005166		JMP DADDWK	
	014376	DADCX,	JMP I DADDXX	
15160	044506	DADDB,	IDR (400000	
	255115		DAC I DADDL	
	244377		DAC DAD'FWM	
	204510		LAC (LAW I I	
15166	245150		DAC DADCP	
	005143		JMP DADDW+2	
15166	215115	DADDWK,	LAC I DADDL	
	404452		ADD (I	
15170	050100		SZA I	
	005157		JMP DADDX	
	040400		SMA	
	005207		JMP DAD'WMM	
15176	215115		LAC I DADDL	
	404414		ADD (I	
	255115		DAC I DADDL	
	205115		LAC DADDL	
15200	424414		SUB (I	
	246115		DAC DADDL	
	215115		LAC I DADDL	
	404506		ADD (400000	
15206	024414		SUB (I	
	255115		DAC I DADDL	
	005157		JMP DADDX	
15207	215115	DADDWM,	LAC I DADDL	
15210	424414		SUB (I	
	255115		DAC I DADDL	
	205115		LAC DADDL	
	424414		SUB (I	
15214	245115		DAC DADDL	
	215115		LAC I DADDL	
	004505		ADD (377777	
	404414		ADD (I	
15220	255115		DAC I DADDL	
	005157		JMP DADCX	
	777777	MADD,	REPEAT 4,2	
15243	777777	MAC,	.-.	/MAC=DIVISION, MAC+4=NUMERATOR, MAC+4=ANSWER
15243	777777	MAC+13.*MODULE/		/MAC + 8% = REMAINDER
15244	777777	DPDIVJ,	.-.	
		DPDIVF,	.-.	/R REG. NUMERATOR IN AC

	244400		DAC *98XX	/4 REGISTER DIVISOR IN ID
	025243		DID OPCIVJ	/CIVISION DDNE BY SHIFTING
	710104		LAW I 68.	/SHIFT CDUNT
15250	244401		DAC *SC	
	044402		DZM *SIGNN	/SIGN DF RESULT
		GG,,	IRP GG,,0,I,2,3*	
			LIO I DPDIVJ	
			LAC I DPDIVF	
			DAC MAC+GG+4	
			DID MAC+GG	
			DZM MAC+GG+8.	
			IDX DPDIVJ	
			IDX DPDIVF	
			ENDIRP	
15252	235243	0,	LIO I DPDIVJ	
	215244		LAC I DPDIVF	
15254	245232		DAC MAC+0+4	
	025226		DID MAC+0	
	045236		DZM MAC+0+8.	
	445243		IDX DPDIVJ	
15260	445244		IDX DPDIVF	
	235243		I,	LID I DPDIVJ
	215244		LAC I DPDIVF	
	245233		DAC MAC+1+4	
15264	025227		DID MAC+1	
	045237		DZM MAC+1+8.	
	045243		IDX DPDIVJ	
	445244		IDX DPDIVF	
15270	235243		2,	LID I DPDIVJ
	215244		LAC I DPDIVF	
	245234		DAC MAC+2+4	
	025230		DID MAC+2	
15274	045240		DZM MAC+2+8.	
	045243		IDX DPDIVJ	
	045244		IDX DPDIVF	
	235243		3	LID I DPDIVJ
15300	215244		LAC I DPDIVF	
	245235		DAC MAC+3+4	
	025231		DID MAC+3	
	045241		DZM MAC+3+8.	
15304	045243		IDX DPDIVJ	
	445244		IDX DPDIVF	
			REPLAY I+2	/KEEP DISPLAY GOING
15307	205226		LAC MAC	
15310	040400		SMA	
	005335		JMP KANKS	
	700001		LAW 1	
	004402		XDR SIGNN	
15314	244402		DAC SIGNN	
		GG,,	IRP GG,,0,I,2,3*	
			LAC MAC+GG	
			SPA	
			CMA	
			DAC MAC+GG	

15319 205226
640200
761000
15320 245226

0,

ENDIRP
LAC MAC+0
SPA
CMA
DAC MAC+0

15321 205227
640200
761000
15324 245227

1,
SPA
CMA
DAC MAC+1

LAC MAC+1

15329 205230
640200
761000
15330 245230

2,
SPA
CMA
DAC MAC+2

LAC MAC+2

15331 205231
640200
761000
15334 245231

3
SPA
CMA
DAC MAC+3

LAC MAC+3

16338	105232		KANKS,	LAC MAC+4
	040400		SMA	
	005363		JMP DPDIVX	
15340	700001		LAW 1	
	044402		XDR SIGNN	
	244402		DAC SIGNN	
		GG,,	IRP GG,,0,1,2,3*	
			LAC MAC+4+GG	
			SPA	
			CMA	
			DAC MAC+4+GG	
15343	205232	0,	ENDIRP	
15344	040200		LAC MAC+4+0	
	761000		SPA	
	245232		CMA	
	205233		DAC MAC+4+0	
15350	040200		1,	LAC MAC+4+1
	761000		SPA	
	245233		CMA	
	205234		DAC MAC+4+1	
15354	040200		2,	LAC MAC+4+2
	761000		SPA	
	245234		CMA	
	205235		DAC MAC+4+2	
15360	040200		3	LAC MAC+4+3
	761000		SPA	
	245235		CMA	
	025500		DAC MAC+4+3	
15364	005605		DPDIVX,	JSP XCDMP
	025423		JMP 98X	/MAC MAC+8, DIVISION ERROR
			JSP XSHIFT	/MAC+MAC+8
15367	025500		REPLAY 1,2	
15370	005372		JSP XCDMP	
	005376		JMP .+2	
	025401		JMP .+5	
	700001		JSP XSLBT	
15374	045232		LAW 1	
	245232		IDR MAC+4	
	044401		DAC MAC+4	
	005365		ISP SC	
15400	005560		JMP DPDIVX+2	
	265422	XSURT,	JMP 97X	/ALL DONE, SD INSERT SIGN
			DAP XSURT	
		GG,,	IRP GG,,0,1,2,3*	
			LAC MAC+GG	
			CMA	
			DAC MACC+GG	
			ENDIRP	
15402	205226	0,	LAC MAC+0	
	761000		CMA	
15404	245222		DAC MACC+0	
	205227		1,	LAC MAC+1
	761000		CMA	
	245223		DAC MACC+1	
15410	205230		2,	LAC MAC+2
	761000		CMA	
	245224		DAC MACC+2	
	205231		3	LAC MAC+3
15414	761000		CMA	
	245225		DAC MACC+3	
	224511			LIO (MACC+10000

	204512		LAC (MAC+8.+10200
			OPR DDAD
15422	005422	XSUBIX,	JMP .
	244403	XSHIFT,	DAC X'SH4X
15424	044404		DZM 'TEMXL
	144405		DZM 'TEMXH
			REPLAY 1,2 /KEEP DISPLAY GOING
			IRP GG.,4,5,6,7,8.,9.,10.,11.*
		GG.,	LID MAC+GG
			JSP GG4LK
			DAC MAC+GG
			LAC TEMXL
			DAC TEMXH
			ENDIRP
15427	225232	4,	LID MAC+4
15430	025706		JSP GG4LK
	245232		DAC MAC+4
	204404		LAC TEMXL
	244405		DAC TEMXH
15434	225233		5,
	025706		JSP GG4LK LID MAC+5
	245233		DAC MAC+5
	204404		LAC TEMXL
15440	244405		DAC TEMXH
	225234		6,
	025706		JSP GG4LK LID MAC+6
	245234		DAC MAC+6
15444	204404		LAC TEMXL
	244405		DAC TEMXH
	225235		7,
	025706		JSP GG4LK LID MAC+7
15450	245235		DAC MAC+7
	204404		LAC TEMXL
	244405		DAC TEMXH
	225236		8.,
15454	025706		JSP GG4LK LID MAC+8.
	245236		DAC MAC+8.
	204404		LAC TEMXL
	244405		DAC TEMXH
15460	225237		9.,
	025706		JSP GG4LK LID MAC+9.
	245237		DAC MAC+9.
	204404		LAC TEMXL
15464	244405		DAC TEMXH
	225240		10.,
	025706		JSP GG4LK LID MAC+10.
	245240		DAC MAC+10.
15470	204404		LAC TEMXL
	244405		DAC TEMXH
	225241		11.
	025706		JSP GG4LK LID MAC+11.
15474	245241		DAC MAC+11.
	204404		LAC TEMXL
	244405		DAC TEMXH
	014403		XSHIFX,
15500	244406	XCDMP,	JMP I XSH4X
			DAC 'XCM4X
		GG.,	IRP GG.,3,2,1,0*
			LAC MAC+GG
			SUB MAC+GG+8.
			ADD I0 /ELIMINATE -0
			SZA I
			JMP .+4
			SMA
			IDX XCM4X
			JMP XCDMPX
			LAC MAC+GG

15501	205231	3,	SZA	
	425241		JMP -3	
	404452		ENDIRP	
15504	650100		LAC MAC+3	
	605511		SUB MAC+3+R.	/ELIMINATE -0
	640400		ADD (0	
	444406		SZA I	
15510	605557		JMP +4	
	205231		SMA	
	640100		IDX XCM4X	
	605510		JMP XCOMPX	
15514	205230		LAC MAC+3	
	425240		SZA	
	404452		JMP -3	LAC MAC+2
	650100		2,	
15520	605524		SUB MAC+2+R.	/ELIMINATE -0
	640400		ADD (0	
	444406		SZA I	
15524	605557		JMP +4	
	205230		SMA	
	640100		IDX XCM4X	
	605523		JMP XCOMPX	
15530	205227		LAC MAC+2	
	425237		SZA	
	404452		JMP -3	LAC MAC+1
	650100		1,	
	605537		SUB MAC+1+R.	/ELIMINATE -0
15534	640400		ADD (0	
	444406		SZA I	
	605557		JMP +4	
15540	205227		SMA	
	640100		IDX XCM4X	
	605536		JMP XCOMPX	
15544	205226		LAC MAC+1	
	425236		SZA	
	404452		JMP -3	LAC MAC+0
	650100		0	
	605552		SUB MAC+0+R.	/ELIMINATE -0
15550	640400		ADD (0	
	444406		SZA I	
	605557		JMP +4	
	205226		SMA	
	640100		IDX XCM4X	
15554	605551		JMP XCOMPX	
	605554		LAC MAC+0	
			SZA	
15557	614406		JMP -3	JMP -1
15560	204402	XCOMPX,	REPLAY 1,2	
	650100	97X,	JMP I XCM4X	
	605604		LAC SIGNN	
			SZA I	
			JMP QHX-1	
		GG,,	IRP GG,,0,1,2,3+	
			LAC MAC+4.+GG	
			CMA	
			ADD (0	
15563	205232		DAC MAC+4.+GG	
15564	761000	0,	ENDIRP	
	404452		LAC MAC+4.+0	
	245232		CMA	
	205233		ADD (0	
	761000		DAC MAC+4.+0	
15570	404452		1,	LAC MAC+4.+1
			CMA	
			ADD (0	

	245233		DAC MAC+4.+1	
	205234		2,	LAC MAC+4.+2
15574	741000		CMA	
	404452		ADD 10	
	245234		DAC MAC+4.+2	
	205235		3	LAC MAC+4.+3
15600	741000		CMA	
	404452		ADD 10	
	245235		DAC MAC+4.+3	
				REPLAY 1,2
15604	205232		LAC MAC+4.	
	414400	98X,	JMP I 98XX	
		CP4X,	REPEAT 4,0	
		DP4N,	+	
		DPDIV4	+	
15614	777777		DAC DP41X	
	244407		DID DP4N	
	525612		LAC I DP4N	
	215612		DAC DP4X	
15620	245606		IDX DP4N	
	446612		LAC I DP4N	
	215612		DAC DP4X+1	
	245607		DZM DP4X+2	
	445610		DZM DP4X+3	
15624	445611		REPLAY 1,2	/KEEP DISPLAY GOING
15626	224513		LAC I IDPDIV4	
	224514		LIO (DP4K+10000)	
15630	175244		JDA DPDIVF	
	214407		LAC I DP41X	
	245606		DAC DP4K	
		GG,,	IRP GG,,0,1,2,3+	
			LAC MAC+4+GG	
			DAC I DP4K	
			IDX DP4X	
			ENDIRP	
15633	205232	0,	LAC MAC+4+0	
15634	255606		DAC I DP4K	
	445606		IDX DP4X	
	205233		1,	LAC MAC+4+1
	255606		DAC I DP4K	
15640	445606		IDX DP4K	
	205234		2,	LAC MAC+4+2
	255606		DAC I DP4X	
	445606		IDX DP4K	
15644	205235		3	LAC MAC+4+3
	255606		DAC I DP4K	
	444407		IDX CP4K	
15650	414407			IDX DP41X
		CP41,	JMP I CP41X	
		DBX,	REPEAT 0.,0	
		DBXM,	+	
		DPDIV	+	
	777777		QDPDIV=DPDIV 7777	
	777777		DAC DBXD	
005662			DID DBXM	
15663	244410		IRP GG,,0,1+	
15664	325661	GG,,	LAC I QDPDIV	
			DAC DBX+GG	
			LAC I DBXM	
			DAC DBX+4.+GG	
			IDX DPDIV 7777	
			IDX DBXM	
			ENDIRP	
15665	215662	0,	LAC I QDPDIV	
	245651		DAC DBX+0	
	225661		LAC I DBXM	

15670	245655	DAC DBX+4.+0	
	445662	IDX OPDIV 7777	
	445661	IDX DBXM	
	215662	1	LAC I QOPDIV
15674	245652	DAC DBX+1	
	215661	LAC I DBXM	
	245656	DAC DBX+4.+1	
	445662	IDX OPDIV 7777	
15700	445661	IDX DBXM	
	204515		LAC (DBX+10000
	224516	LID (DBX+4+10000	
	175244	JDA OPDIVF	
15704	225233	LID MAC+5	

ADDRESS	DATA	OPERATION	COMMENT
15705	814418	Q8XD, JMP I DRXD	
15706	265720 760202	GG4LK, OAP .+12 CLA	
15710	667023 024414 244404 477023	SCL 25 AND 11 OAC TFMXL SCR 25	
15714	663777 663777 665001 044405	RCL 95 RCL 95 SAL 15 IOR TFMXH	
15720	605720	JMP .	
/BASELINE TAPE ROUTINES FOR IBM EQUIPMENT -- 2/26/65			
722046	SW1=722046		
726046	SW0=726046		
	DEFINE	SWAP	
		RCL 95	
		RCL 95	
	TERMINATE		
15721	015721	QQQBEG QQQBEG	
		REPEAT 0IF VP QQQBEG-100,PRINTX (
LOCATION OF TAPE PACKAGE MAY INTERFERE WITH SEQUENCE BREAK SYSTEM.			
(*			
15722	000000 000001	QQQDEN, 0 QQQUNT, 1	/DENSITY, 0 FOR 200 CPI, 1 FOR 556, 2 FOR 800 /UNIT, 0 THRU 7
15724	000000 000000 000000 000000 000000	QQQPAR, 0 QQQRW1, 0 QQQSCF, 0 QQGRP, 0	/PARITY, 0 ODD, 1 EVEN /REWIND INDICATOR, 0 FOR NO REWIND, 1 FOR REWIND /POSITIVE MEANS START OF FUNCTION, NEGATIVE OTHERWISE /RECORD POINTER
15730	000000 000000	QQQJS, 0 QQQDU, 0	/LOC(JSP) TO TAPE PACKAGE /DUR
15732	176257	QQQWR, JDA QQQINT	/INITIALIZE
15733	710003	QQQWR2, LAW 1 3	
15734	246566 710003 246567	OAC QQQTC LAW 1 3 OAC QQQRWC	/INITIALIZE BLANK TAPE COUNTER /INITIALIZE REWRITE COUNTER
15740	626037 731071	QQQWR1, REPLAY 1,2 JSP QQQTCZ 731071	/GO TO TCU-UNIT FREE SR, SETTING S0F TO +0
15742	626127	QQQWR6, JSP QQQPC	/PROCESS CALLING SEQUENCE FOR DATA CHANNEL
15743	720346	SIA	
15744	226560 726046	LIO QQQWC SW0	/SWC OUT
15746	026215 000001	JSP QQQXF 1	/EXECUTE FUNCTION, TEST FOR ACCEPTANCE AND COMPLETION. /INCREMENT RECORD COUNT

15750	005754 700005 405730 000313	JMP 000WR7 LAW 5 000WR7, ADD 000JS JMP 000OUT	/ERROR RETURN /NO ERROR--GO TO NORMAL RETURN /GO BACK TO MAIN PROGRAM
15750	026024	000WR7, JSP 000EPE	/GO TO SEE IF ANY ERRORS BESIDE END PT
15750	005761	JMP 000WR8	/NON-END-PT ERRORS
15756	764000 700004	000W12, CLI LAW 4 JMP 000WR7	/INDICATES END PT NOT DURING WRITE BLANK TAPE /GO TO END PT RETURN IN MAIN PROGRAM
15760	005752		
15761	026037 730471	000WR8, JSP 000TCZ 730471	/BASIC BACKSPACE FUNCTION
16763	026214	JSP 000EXF-1	/DISCONNECT DATA CONTROL AND EXECUTE FUNCTION
15760	777776 000005 000567 005737	-1 JMP 000REW ISP 000RWC JMP 000WR1	/DECREMENT RECORD COUNT /ERROR RETURN FROM BACKSPACE AFTER WRITE /NORMAL RETURN /REWRITE
15770	710010 246552	LAW 1 10 OAC 000CTI	/SET COUNTER TO WRITE BLANK TAPE 8 TIMES FOR A TOTAL 0
15772	026037 731071	000W12, JSP 000TCZ 731071	/BASIC WRITE MTF
15774	026214 777777 000011 000552 005772	JSP 000EXF-1 -0 JMP 000RTE ISP 000CTI JMP 000W12	/DISCONNECT DATA CONTROL AND EXECUTE FUNCTION /GO NOT CHANGE RECORD COUNT. /ERROR RETURN FROM WRITE BLANK TAPE /NORMAL RETURN
16000			/6 INCHES BLANK TAPE WRITTEN.
16001	000566 005735	ISP 000BTC JMP 000WR3	/INIT. REWRITE COUNTER
16003	700003 005752	000W13, LAW 3 JMP 000WR7	/GO TO UNSUCCESSFUL RETURN IN MAIN PROGRAM
16009	026336 226536 026241 005766	000REW, JSP 000CSST L10 000C9 JSP 000ETY JMP 000WR9	/SAVE STR AND ILC. /GO TO NORMAL RETURN
16011	026024 000015 226554	000RTE, JSP 000EPE JMP 000RTE L10 000OU2 JMP 000W12	/BLANK TAPE ERROR /THERE ARE NON-END-PT ERRORS /MAKE IO NEGATIVE IMPLIES END PT DURING WRITE BLANK TA /GO TO END PT RETURN IN MAIN PROGRAM
16014	005757		
16015	026336 226537 026241	000RTE, JSP 000CSST L10 000C10 JSP 000ETY	/SAVE STATE
16020	001177 040200 000013	RAL 75 SPA JMP 000RTE 2	/END POINT

16023	005777	JMP QQQW11	/CONTINUE WRITE OPERATIONS
16024	266232	QQQEPX, DAP QQQEPX	/ROUTINE TO DETERMINE IF OTHER ERRORS BESIDE END PT
16027	026562	SWAP	/BRING ROTATED STATE REGISTER INTO AC
16030	050100	AND QQQMK1	/MASK OUT T10E BIT AND ALL NON-ERROR BITS
	046032	SZA 1	
	006032	IDX QQQEPX	/NO OTHER ERRORS BESIDE END PT
		JMP .	
16033	226554	QQQTC2, L10 QQQDU0	/TCU-UNIT FREE SR
16034	025726	D10 QQQSOF	/SET QQQSOF NEG MEANS NOT START OF FUNCTION
	266103	DAP QQQTCX	
	006060	JMP QQQTC3-2	
16037	045726	QQQTC2, D1M QQQSOF	/SET QQQSOF POSITIVE MEANS START OF FUNCTION
16040	266103	DAP QQQTCX	/SET TO 1+LOC(JSP QQQTC2)
	266045	DAP QQQTC2	
		REPLAY 1,2	
16043	205724	LAC QQQPAR	
16044	065177	SAL 75	/MOVE PARITY INDICATOR INTO BIT 10
	046045	TOR .	/CONSTRUCT FUNCTION WITH CORRECT PARITY
	246220	DAC QQQEX1	/STORE INTO EXECUTION ROUTINE
	046103	IDX QQQTCX	/SET TO 2+LOC(JSP QQQTC2)
16050	700001	LAW 1	
	005722	ACD QQQDEN	
	065007	SAL 35	
	045723	TOR QQGUNT	
16054	065077	SAL 65	
	045725	TOR QQQRW1	
	046554	TOR QQQDU0	
	245731	DAC QQQDU	/STORE SELECT INSTRUCTION
16060	206527	LAC QQQC1	
	246553	DAC QQQCT	/SET COUNTER TO -66666 DECIMAL
	720072	SFC	
	006065	JMP QQQTC4	
16064	006101	JMP QQQTD1	
	026336	JSP QQQSST	
16067	066553	REPLAY 1,2	
16070	006062	TSP QQQCT	
	720073	JMP QQQTC3	
		CGO	/TCU NOT FREE WITHIN 5 SECS
16072	226530	L10 QQQC2	
	205726	LAC QQQSOF	
16074	040200	SPA	
	226531	L10 QQQC3	
		REPLAY 1,2	
16077	026241	JSP QQQCTY	/GO TO ERROR TYPEOUT SPECIFYING CB1 OR CB2
16100	006253	JMP QQQET1	/GO TO HALT AGAIN
16103	205726	QQQTD1, LAC QQQSOF	/TCU FREE--IS THIS START OF FUNCTION
	040200	SPA	
	006103	JMP .	/NORMAL EXIT
16104	205731	XCT QQQDU	/SELECT TAPE
		REPLAY 1,2	
16106	720172	RSR	
	072001	RIR 15	
16110	042000	SPI	

	006104		JMP QQQTD2	/TAPE IS REWINDING
16112	206527		LAC QQQC1	
	246553		DAC QQCT	/SET COUNTER TO -66666 DECIMAL
16118	920172	QQQTD3,	RSR	
	652000		SPI I	
	006103		JMP QQCTCX	/NORMAL EXIT
	026336		JSP QQCSST	/SAVE STR AND ILC
16120	066553		ISP QQCT	
	006114		JMP QQQTD4	
	720073		CGD	/UNIT NOT FREE WITHIN 5 SECS
	226532		LIO QQCC4	
16125	626241		REPLAY 1,2	
	006104		JSP QQCTY	
			JMP QQCTD2	/TRY AGAIN
16127	266154			/SR TO LOAD DATA CONTROL
16130	206306	QQCPDC,	DAP QQCPDX	/SET UP RETURN
	246557		LAC QQQIN1	/RC(IST ADDRESS OF OUTPUT OR INPUT BLOCK)
	640200		DAC QQCIA	
	006210		SMA	
16134	026534		JMP QQCPDJ	/ILLEGAL CALLING SEQUENCE
	640400		SUB QQCT	/1ST ADDRESS - 040000
	006210		SMA	
			JMP QQCPDJ	/ILLEGAL CALLING SEQUENCE
16137	206307		LAC QQQIN2	/RC(1+LAST ADDRESS OF OUTPUT OR INPUT BLOCK)
16140	426557		SUB QQCIA	
	246560		DAC QQWC	/STORE TENTATIVE WORD COUNT
	050500		SPQ	
	006210		JMP QQCPDJ	/ILLEGAL CALLING SEQUENCE
16148	206307		LAC QQQIN2	
	026534		SUB QQCT	/((1+LAST ADDRESS) - 040000)
	640500		SZM	
	006210		JMP QQCPDJ	/ILLEGAL CALLING SEQUENCE
16150	206154		LAC QQCPDX	
	526546		SAS QQCT17	
	006155		JMP QQCPDE	/SETTING UP EDR A READ OR READ COMPARE
16153	226557	QQCPDC,	LID QQCIA	
16154	006154	QQCPDX,	JMP .	
16155	206550			/SETTING UP FOR A READ OR READ COMPARE, MORE CHECKING
	640100	QQCPDE,	LAC QQRC1	
	006177		SZA	
			JMP QQCPDF	/READ COMPARE
16160	206306		LAC QQQIN1	
	025721		SUB QQQDEN-1	/ACTUALLY SUBTRACTING VALUE OF QQQBEG
	040400		SMA	
	006172		JMP QQCPDI	
16164	710001		LAW I 1	
	006307		ADD QQQIN2	
	026570		SUB QQQRWC 1	/ACTUALLY SUBTRACTING VALUE OF QQQEND
	640400		SMA	
16170	006210		JMP QQCPDJ	/READ-IN REGION OVERLAPS TAPE PACKAGE, ILLEGAL.
	006153		JMP QQCPDC	/READ-IN REGION DOESNT OVERLAP TAPE PACKAGE, LEGAL.
16172	206306	QQCPDI,	LAC QQQIN1	
	026570		SUB QQQRWC 1	/ACTUALLY SUBTRACTING VALUE OF QQQEND
16174	050500		SPQ	
	006210		JMP QQCPDJ	/READ-IN REGION OVERLAPS TAPE PACKAGE, ILLEGAL.

	006153		JMP QQCP00	/READ-IN REGION DOESNT OVERLAP TAPE PACKAGE. LEGAL.
16177	206306	QQPDF,	LAC QQCIN1	
16200	026547		SUB QQRCB	
	040400		SMA	
	006210		JMP QQCPQJ	/REFERENCE REGION OVERLAPS READ-COMPARE BUFFER. ILLEGAL
	205721		LAC QQCQEN-1	
16204	026547		SUB QQRCB	
	040400		SMA	
	006210		JMP QQCPQJ	/TAPE PACKAGE OVERLAPS READ-COMPARE BUFFER. ILLEGAL.
	006153		JMP QQCP00	/LEGAL.
16210	226535	QQCPQJ,	L10 QQCB	
			REPLAY 1,2	
16212	026241		JSP QQQETY	/TYPE OUT ERROR MESSAGE FOR ILLEGAL CALLING SEQUENCE.
	006003		JMP QQQW13	/GO TO UNSUCCESSFUL RETURN
				/ROUTINE TO EXECUTE FUNCTION AND WAIT FOR COMPLETION
16214	720146		SDF	
	206240	QQQEXF,	OAP QQQEXX	/SET UP RETURN
	206230		OAP QQQEX2 1	
16220	205731	QQQEX1,	XCT QQCDU	/SELECT TAPE# CLEARING INDICATORS IN STATE REGISTER.
	000000		0	/FUNCTION TO BE EXECUTED IS PRESTORED HERE.
	720072		SFC	
	006227		JMP QQQEX2	/FUNCTION ACCEPTED
	226533		L10 QQCC5	
			REPLAY 1,2	
16223	026241		JSP QQQETY	/FUNCTION NOT ACCEPTED--TYPE ERROR MESSAGE
	006217		JMP QQQEX1	/TRY AGAIN
16227	026033	QQQEX2,	JSP QQQTC0	/FUNCTION ACCEPTED--IS TCU FREE IN LESS THAN 5 SECS.
16230	206230		LAC .	/PICK UP RECQD NUMBER INCREMENT OR DECREMENT
	005727		ADQ QQCRP	
	245727		OAC QQCRP	
	046240		IDX QQQEXX	
16234	720172		RSR	
	062001		R1L 15	
	052000		SPI 1	
	046240		IDX QQQEXX	
16240	006240	QQQEXX,	JMP .	
				/ERROR TIMEOUT ROUTINE
16241	206256	QQQETY,	OAP QQQETX	/SET UP RETURN
16250	226961		REPEAT 3,R1L 65	TYO
	730003		L10 QQCMK2	/PUT CQCE FOR CARRIAGE RETURN IN RIGHT 6 BITS
			TYO	
			REPLAY 1,2	
16253	206555	QQQET1,	LAC QQCSTR	
16254	226556		L10 QQCILC	
	760400	QQQET2,	HLT	
	006256	QQQETX,	JMP .	/RETURN TO PROGRAM WHICH CALLED.
				/INITIALIZATION ROUTINE
16257	000000	QQQINT,	0	
16260	720033		CKS	
	720054		LSM	
	726305		O10 QQQIN0	
	206304		OAP QQQINX	
16264	005725		OZM QQQRW1	
16265	770001		LAW I 1	

	406257		ACQ QQCINT	
	245730		QAC QQCJS	
16270	724074		EEM	
	706306		LAW QQCIN1	
	266276		OAP QQCIN7	
	710005		LAW 1 5	
16274	246552		OAC QQCCT1	
	216257	QQCIN6,	LAC 1 QQCINT	
	246306	QQCIN7,	OAC QQCIN1	
	446257		ICX QQCINT	
16300	446276		ICX QQCIN7	
			REPLAY 1,2	
16302	466552		ISP QQCCT1	
	406275		JMP QQCIN6	
16304	406304	QQCINX,	JMP .	
16305	000000	QQCIN0,	0	/STATUS INFO
	000000	QQCIN1,	0	/1ST WORD FOLLOWING JSP
	000000	QQCIN2,	0	/2ND WORD FOLLOWING JSP
16310	000000	QQCIN3,	0	/3RD WORD FOLLOWING JSP
	000000	QQCIN4,	0	/4TH WORD FOLLOWING JSP
	000000	QQCIN5,	0	/5TH WORD FOLLOWING JSP
16313	246335	QQCOUT,	OAC QQCQUX	/EXITING ROUTINE
16314	026551		AND QQCQUX	/MASK WITH 030000 TO EXTRACT MODULE NUMBER
	246312		OAC QQCIN5	
	760300		LAP	
	026551		AND QQCQUX	
16320	626312		SAS QQCIN5	/RETURN IS IN SAME MODULE AS TAPE PACKAGE.
	006324		JMP QQCQU1	
	760200		CLA	
	006335		CIP QQCQUX	/CLEAR BITS 0-5
16324	206257	QQCQU1,	LAC QQCINT	
	661001		RAL 15	
	640400		SMA	
	720074		LEM	/LEAVE EXTEND MODE IF APPROPRIATE
16330	206305		LAC QQCIN0	/BRING BACK STATUS INFO TO CHECK INITIAL STATE OF SEQ.
	461077		RAL 65	
	640200		SPA	
	720055		ESM	
16334	616335		JMP 1 QQCQUX	/EXIT
	000000	QQCQUX,	0	
16336	266344	QQCSST,	OAP QQCSSX	
	720336		RLC	
16340	826556		OIO QQCILC	
	720172		RSR	
	826555		OIO QQCSTR	
16344	406344	QQCSSX,	REPLAY 1,2	
			JMP .	

16345	176257	QQQWF,	JDA QQINT	/WRITE END OF FILE SECTION
	626037	QQWF1,	JSP QQCTCZ	
	733271		733271	/WRITE EOF FUNCTION
16350	626214		JSP QQEXF-1	/DISCONNECT DATA CONTROL AND EXECUTE FUNCTION.
	000001		1	/INCREMENT RECORD COUNT
	006355		JMP QQWF2	/ERROR RETURN
	700002	QQWF4,	LAW 2	
16354	005752		JMP QQWRY	/RETURN TO NORMAL RETURN IN MAIN PROGRAM
16355	626024	QQWF2,	JSP QQCEPE	
	006361		JMP QQWF3	/THERE ARE NON-END-PT ERRORS
	700001	QQWF5,	LAW 1	/ONLY END POINT
16360	005752		JMP QQWRY	/GO TO END POINT RETURN OF MAIN PROGRAM.
	626336	QQWF3,	JSP QQCSST	/SAVE STATE
	226542		LIO QQCT13	
	626241		JSP QQCTY	
16364	061177		RAL 75	
	040200		SPA	
	006357		JMP QQWF2 2	/GO TO END POINT RETURN OF MAIN PROGRAM
	006353		JMP QQWF1 5	/GO TO NORMAL RETURN OF MAIN PROGRAM
				/SECTION FOR READ AND READ COMPARE
16370	346550	QQRD,	DYM QQRCI	/SET READ COMPARE INDICATOR TO STRAIGHT READ
	176257		JDA QQINT	
16372	710003	QQRD2,	LAW 1 3	
	246565		DAC QQPRD	
16374	626037	QQRC1,	JSP QQCTCZ	
	731471		731471	
16376	626127	QQRD3,	JSP QQCPDC	/PROCESS THE CALLING SEQUENCE.
16377	720346	QQRD8,	SIA	
16400	226560		LIO QQWC	
	722046		SWI	/SWC IN
16402	626215		JSP QQEXF	/EXECUTE FUNCTION, TEST FOR ACCEPTANCE AND COMPLETION.
	000001	QQRD6,	1	/INCREMENT RECORD COUNT
16404	606412		JMP QQRD4	/ERROR RETURN
	672037		RIX 55	/NO ERROR--MOVE EOF BIT INTO SIGN.
	442000		SPI	
	005757		JMP QQCT12	/END OF FILE RETURN.
16410	226550		LIO QQRCI	
	605751		JMP QQWRY-1	/NORMAL RETURN
16412	626037	QQRD4,	JSP QQCTCZ	

16413	730471	730471	/BASIC BACKSPACE FUNCTION
16414	426214 777776 806422	JSP QQCEXF-1 -1 JMP QQCBER	/DISCONNECT DATA CONTROL AND EXECUTE FUNCTION /DECREMENT RECORD COUNT /ERROR RETURN FROM BACKSPACE AFTER READ
16418	406565	QQQRD5, JSP QQQRD	/NORMAL RETURN FROM BACKSPACE
16420	606374	JMP QQQR01	/RE-READ
16421	606003	JMP QQCW13	/GO TO UNSUCCESSFUL RETURN IN MAIN PROGRAM.
16422	626336	QQCBER, JSP QQCSST	/SAVE STATE
	226540	LIO QQCC11	
16424	626241	JSP QQCETY	
	606417	JMP QQQRD5	/NORMAL RETURN
			/SECTION FOR SPACE FUNCTION
16426	176257	QQQSP, JOA QQQINT	
	226413	LIO QQQR04	/BASIC BACKSPACE FUNCTION
16430	206306	LAC QQCINI	/PICK UP PLUS OR MINUS THE NUMBER OF RECORDS TO BE SPA
	440400	SMA	
	226375	LIO QQQR01	/BASIC FORWARD FUNCTION
	826447	DIO QQQSP4	
16434	226415	LIO QQQRD4	-1
	640400	SMA	
	226403	LIO QQQRD6	+1
	526461	OIO QQQSP5	
16440	640400	SMA	
	761000	CMA	
	605775	SAD QQCW10	3
	605757	JMP QQCW12	/ZERO SPACING REQUIRED!--GO TO NORMAL RETURN
16444	246552	OAC QQCT1	/COUNTER CONTAINS -(NO. RECORDS TO SPACE)
		REPLAY 1,2	
16446	426037	QQQSP3, JSP QQQTCZ	
	000000	QQQSP4, 0	/BASIC FUNCTION IS PRESET
16450	205727	LAC QQQR0	/PICK UP RECORD POINTER
	040100	SZA	
	606460	JMP QQQSP5-1	/RECORD POINTER NOT 0---PERFORM SPACING FUNCTION
16454	206306	LAC QQCINI	/PICK UP '+' NUMBER OF RECORDS TO SPACE
	640400	SMA	
	606460	JMP QQQSP5-1	/PERFORM FORWARD SPACING FUNCTION
	226552	LIO QQCT1	
	606353	JMP QQQWF4	/GO TO RECORD 0 RETURN IN MAIN PROGRAM
16460	426214	JSP QQCEXF-1	/DISCONNECT DATA CONTROL AND EXECUTE FUNCTION.
	777776	-1	/-1 OR +1
	606473	JMP QQQESP	/ERROR RETURN
	720172	RSR	/NO ERROR--BRING STATE INTO IO
16464	672017	RIR 45	/ROTATE EOF BIT INTO SIGN
	042000	SPI	
	806477	JMP QQQSP7	/EOF FOUND.
		REPLAY 1,2	

16478	446552 406446 405757	ISP QQCT1 JMP QQSP3 JMP QQW12	/SPACE SOME MORE. /GO TO NORMAL RETURN.
16473	426336	QQESP, JSP QQSST	/ERROR FROM SPACING--SAVE STATE
16474	226541 426241 406463	LIO QQCT12 JSP QQCTY JMP QQSP6	/ERROR TYPEOUT /NORMAL RETURN
16477	446552	QQSP7, ICX QQCT1	
16508	226552 406003	LIO QQCT1 JMP QQW13	/GO TO END OF FILE RETURN.
16502	376257	QQREW, JDA QQINT	/SECTION FOR REWIND
	704000	LAW 4000	
16504	245725	OAC QQRW1	/SET REWIND INDICATOR TO REWIND
16505	426037	JSP QQCTZ	
	730471		/BASIC BACKSPACE FUNCTION
	472077	RIR 65	
16510	442000	SP1	
	406515	JMP QQRW1	/AT LOAD POINT
16512	426214	JSP QQEXF-1	/DISCONNECT DATA CONTROL AND EXECUTE FUNCTION.
	400000		
16514	406517	JMP QQRW2	/ERROR RETURN
	345727	QQRW1, OZM QQCRP	/NO ERROR--RESET RECORD POINTER
16516	406357	JMP QQWF5	/GO TO NORMAL RETURN IN MAIN PROGRAM
16517	426336	QQRW2, JSP QQSST	/SAVE STATE
16520	226543	LIO QQCT14	
	710700	LAW 1700	/MASK TO REMOVE PARITY AND DENSITY FROM STATE INDICATOR
	026555	AND QQSTR	
	526545	SAS QQCT16	
16524	426241	JSP QQCTY	
		REPLAY 1,2	
16526	406515	JMP QQRW1	
16527	575625	QQCT1, -66666.	/CONSTANTS, TEMP STORAGE, MASKS, MESSAGES AND COUNTERS
16530	436201	QQCT2, TEXT (CB1	
		(
16531	636202	QQCT3, TEXT (CB2	
		(
16532	246200	QQCT4, TEXT (UB	
		(
16533	444561	QQCT5, TEXT (FNA	
		(
16534	040000	QQCT7, 040000	
	716322	QQCT8, TEXT (ICS	
		(
16536	456226	QQCT9, TEXT (EBW	
		(

16537	456223	QQQC10,	TEXT (EBT	
16540	456251	QQQC11,	TEXT (EBR	{
16541	452247	QQQC12,	TEXT (ESP	{
16542	452666	QQQC13,	TEXT (EWF	{
16543	455126	QQQC14,	TEXT (ERW	{
16544	042000	QQQC15,	2000	
	000001	QQQC16,	600001	
	006377	QQQC17,	JMP QQCRD3 1	
16550	036000	QQQRCB,	036000	/START OF READ COMPARE BUFFER
	000000	QQQRC1,	0	/READ COMPARE INDICATOR, 0 FOR STRAIGHT READ, - FOR RE
	030000	QQQOCU,	030000	
16552	000000	QQQCT1,	0	
	000000	QQQCT,	0	
16554	720070	QQQOU0,	720070	
	000000	QQQSTR,	0	
	000000	QQQ1LC,	0	
	000000	QQQ1A,	0	
16560	000000	QQQWC,	0	
16561	177777	QQQMK2,	177777	
	370001	QQQMK1,	370001	
16563	000000	QQQTEM,	0	
16564	000000	QQQTM1,	0	
16565	000000	QQQRRC,	0	/REREAD COUNTER
	000000	QQQBTC,	0	/BLANK TAPE COUNTER
	000000	QQQRWC,	0	/REWRITE COUNTER
16570	016570	QQQEND	QQQEND	

REPEAT 01F VZ QQQEND 770000-QQQBEG 770000,PRINTX {

TAPE PACKAGE OVERLAPS CORE MODULES AND WILL NOT OPERATE PROPERLY.

{*

START

		/MODULE 2 SCOPE DISPLAY	
20000	020137	20000/	
20000	221761	TEXTLINES	20137
	060066	221761	
		060066	
	130000	REPEAT 52.9	TEXTLINES
20070	003000	130000	/ESCAPE
	034137	3000	/STOP
	221673	CHANNELS	34137
	060066	221673	
20074	037061	060066	
	454565	TEXT /CHA	
	432200	NNE	
	000100	LS	
20100	000200		1
	000300		2
	000400		3
			4/
20103	730000	130000	/ESCAPE
		DEFINE	BTEXT A,B,C
		A	24137
			220000+B
			060000+C
		TERMINATE	
		BTEXT CONTINUE,33,711	
20107	034645	TEXT /CON	
20110	237145	TIN	
	246500	UE/	
20112	130000	130000	/ESCAPE
	003000	3000	/STOP
		BTEXT NEXTFILE,66,66	
20117	456527	TEXT /NEX	
20120	230066	T F	
	714365	ILE	
20122	130000	130000	/ESCAPE
		BTEXT TYP0UT,66,1535	
20126	233047	TEXT /TYP	
	650046	E O	
20130	242300	UT/	
20131	730000	130000	/ESCAPE
		BTEXT TYPIN,66,1205	
20133	233047	TEXT /TYP	
	650071	F I	
	450000	N/	
20140	130000	130000	/ESCAPE
		BTEXT THISFILE,66,416	
20144	237071	TEXT /THI	
	220066	S F	
	714365	ILE	
20147	130000	130000	/ESCAPE
20150	003000	3000	/STOP

20154	644663 204465 452300	BTEXT DOCUMENT,33,242 TEXT /DOC UME NT/
20157	130000	130000 /ESCAPE
20160	003000	3000 /STOP
20164	665161 446500	BTEXT FRAME,66,66 TEXT /FRA MF/
20166	130000	130000 /ESCAPE
20172	224346 260000	BTEXT SLOW,66,416 TEXT /SLO W/
20174	130000	130000 /ESCAPE
20200	444664 655161 236500	BTEXT MODERATE,66,1205 TEXT /MOD ERA TE/
20203	130000	130000 /ESCAPE
20207	666122	BTEXT FAST,66,1535
20210	230000	TEXT /FAS T/
20211	130000 003000	130000 /ESCAPE 3000 /STOP

20216	227167		RTXT INFO,1673,1100
	446100		227167 /SIGMA =
20220	320000		446100
	000000	INFO1	320000
	000000		000000
	000000		000000 /SIGMA
	000000		000000
20224	000013		000013 /ESCAPE
	034037		034037
	221640		221640
	061100		061100
20230	452444		452444
	626551		626551
	004666		004666
	002351		002351
20234	616365		616365
	220032		220032
	000000	INFO2	000000
	000000		000000 /NUMBER OF TRACES
	000000		000000
20240	000013		000013 /ESCAPE
	034037		034037
	221605		221605
20244	061100		061100
	446127		446127
	001600		001600
	271600		271600
20250	003200		003200
	000000	INFO3	000000
	000000		000000 /MAX X
	000000		000000
20254	130000		130000
	034037		034037
	221552		221552
	061100		061100
20260	237144		TEXT /TIM
	050026		E W
	065164		ORO
			/
20263	003200		003200
20264	000000	TAPINF	000000
	000000		000000
	000000		000000
	130000		130000
20270	034037		034037
	221517		221517
	061100		061100
	235161		TEXT /TRA
20274	636500		CE
	454673		NO.
			/
20276	003200		003200
	000000	TAPINK	000000
20300	000000		000000
	000000		000000
	130000		130000
	003000		003000
20304	034157	SORRY	034157 /STOP
	221000		221000
	060070		060070
	074365		TEXT /PLE

20310 412265
002324
514600
222346
20314 470062
242323
404500
406666

ASE
TU
RN
STO
P 8
UTT
CN
OFF /

20320 130000
003000
001540
20322 034117
221540
20324 100777

003000
034117
220207
21150 100066
23431 003000
23431 003000

130000 /ESCAPE
3000 /STOP
SOTOSC=1540
TRACE 034117
220000+SOTOSC
100777
REPEAT 400., TRACE /TRACE DISPLAY BUFFER AREA
3000
THYTB 34117
220207
100066
+20000+1200./
3000
DEFINE UPXW /UPPER LIMIT
24117
220000
100000
200226
200054
200226
313626
213426
713426

TERMINATE
DEFINE LOXW /LOWER LIMIT
24117
220000
100000
200226
200054
200226
213626
313426
613426
3000 /STOP

TERMINATE
LIMITS REPEAT 8., UPXW LOXW
BTEXT TMCTFR,115,122
360000
130000 /ESCAPE
3000 /STOP
TIMCRT=TMCTFR
BTEXT TMCTSL,115,452
360000
130000 /ESCAPE
3000 /STOP
BTEXT TMCTMO,115,1275
360000
130000 /ESCAPE
3000 /STOP
BTEXT TMCTFA,115,1571
360000
130000 /ESCAPE
3000 /STOP

23665 360000
130000
003000
023662

23673 360000
23674 130000
003000

23701 360000
130000
003000

23707 360000
23710 130000
003000

	DEFINE	NAME1	
		34137	
		222000	/ALLOWS FOR 6
		002000	/CHARACTER NAME
		000000	
		000000	
		130000	
		3000	/STOP
	TERMINATE	NAME	REPEAT 8., NAME1
	DEFINE	KAROTE	A,B,C
	A	BTEXT	A,B,C
		300013	
		3000	/STOP
	TERMINATE		
		KAROTE	NAMCRT,0,0
		KAROTE	CRTCON,60,777
		KAROTE	CRTNF,115,141
		KAROTE	CRTT0,115,1616
		KAROTE	CRTT1,115,1246
		KAROTE	CRTT2,115,472
		KAROTE	CRTDOC,60,310
		KAROTE	DATAX,0,0
24052	020117	BASELN	020117
	220207		220207
24054	102066		102066
	200177		200177
	200177		200177
	200177		200177
24060	200177		200177
	200177		200177
	200177		200177
	200177		200177
	200177		200177
	200177		200177
24064	000032		000032
	003000		003000
	034137	CRTMU	034137
	220207		220207
24070	002000		002000
	050013		050013
	034137		034137
	220172		220172
24074	000000		000000
	300013		300013
	003000		003000
			/STOP
24077	034157	CHNMES	034157
24100	221000		221000
	000070		000070
	074365		074365
	012265		012265
24104	002265		002265
	036563		036563
	230061		230061
	004365		004365
24110	070143		070143
	002361		002361
	070500		070500
	037061		037061

ASE
SE
LEC
T A
LE
GAL
TA
PE
CHA

24114 454565
430000

NNE
L/

24116 000013
003000

13
3000

24120 034157
221000
060070
437144

LSDNC

34157
221000
060070
TEXT /LIM

24124 112300
226523
060465
047145

IT SET DE FIN ITI ON IS NOT CO MPL ETE

24130 112371
044500
112200
454623

24134 006346
444743
052365

24137 137700
24140 000047
436561
226500

P LEA SE TUR N O N L IMI TS BUT TON AN D F INT SH. /

24144 450046
450043
114471
232200

24160 022423
234645
006145
440066

24154 114571
227073

24156 000013
003000

PTDASL

13
3000
34157
221000
060070
TEXT /PLE ASE

24164 012265
002324
014500
406666

TU RN OFF AL L S UBL IMI T B UTI ONS /

24170 006143
430022
246243
114471

24174 230062
242323
404522

24177 000013
24200 003000

13
3000

BCI

TEXT /N UMB ER OF OAT A P OIN

24202 144572
244462
055100

24204 466600
046123
010047
007145

24210 232200
743372

24212 744472
456145
24214 807433
720000

24216 744772
614662
24220 416271
437123
300046
440044
24224 456145
807433
720000

24227 747172
24230 452365
475161
430047
514662
24234 416271
437123
300046
440100
24240 010022
716744
410074
837200

24244 742272
716744
410074
837200

24250 747172
452365
475161
430047
24254 614662
416271
437123
300046

24260 440100
020022
716744
410074
24264 837200

24268 747172
452365
475161
24270 430047
514662
416271
437123
300046

24274 440100
030022
716744
24300 410074
837200

24302 746772

TS
= /

8C2 TEXT /M
EAN
= /

8C3 TEXT /P
ROB
ABI
LIT
Y O
F M
EAN
= /

8C4 TEXT /I
NTE
GRA
L P
ROB
ABI
LIT
Y F
OR
1 S
IGM
A
= /

8C3A TEXT /S
IGM
A
= /

8C5 TEXT /I
NTE
GRA
L P
ROB
ABI
LIT
Y F
OR
2 S
IGM
A
= /

8C6 TEXT /I
NTE
GRA
L P
ROB
ABI
LIT
Y F
OR
3 S
IGM
A
= /

8C7 TEXT /G

24304 516145
244361
517123
000000
743372

24310 744472
412771
442444
002700
743372

24315 744472
714571
442444
002700
743372

24322 744472
712247
436163
454465
452300
406600

24330 226543
456323
456400
270074
743372

24335 747172
452365
475161
430047
114662
416271

24344 437123
000046
400022
454365
432365

24350 440062
414564
267164
237000
743372

031000

24411

24411 000124
000777
475000
24414 000001
012445
000002
000004

RAN
ULA
RIT Y
= /
BC8 TEXT /M
AXI
MUM
X
= /
BC9 TEXT /M
INI
MUM
X
= /
BC10 TEXT /D
ISP
LAC
EME
NT OF
SEL
ECT
ED
X
= /
BC11 TEXT /I
NTF
GRA
L P
ROB
ABI
LIT
Y O
F S
ELE
CTE
D R
AND
WID
TH
= /

DATA=31000

EQUALS NAME1,NULL
EQUALS LOXW,NULL
EQUALS UPXW,NULL
EQUALS @TEXT,NULL
EQUALS KAROTE,NULL

VARIABLES

CONSTANTS

24420 000006
 015117
 015120
 010622
 24424 014270
 001336
 000122
 001750
 24430 001554
 001546
 000214
 000117
 24434 001534
 010612
 010620
 010614
 24440 000121
 115726
 233654
 010310
 24444 003240
 000014
 004713
 023420
 24450 005557
 000577
 000000
 007777
 24454 002445
 001533
 014271
 777744
 24460 001777
 000033
 003000
 014564
 24464 004342
 014610
 000047
 000277
 24470 004557
 004534
 004273
 014612
 24474 001776
 777727
 300077
 737400
 24500 637400
 014630
 014634
 014747
 24504 014750
 777777
 400000
 700001
 24510 710001
 015222
 015286
 015613
 24514 015606
 015651
 015655
 24570
 24576 760400
 004576

HGQYKD, HLT
 START HGQYKD

DISTRIBUTION LIST

Director's Office

D. E. Dustin
C. R. Wieser

Division 2

F. C. Frick

Group 21

G. Farrell
O. V. Fortier
V. J. Guethlen
J. H. Halberstein
P. J. Harris
R. M. Horowitz
H. L. Kasnitz (5)
G. M. Shannon (5)
L. J. Sullivan
L. C. Wilber
F. A. Wilson

Group 22

D. F. Clapp
A. A. Grometstein
W. Z. Lemnios
J. Salerno
B. J. Schafer

Group 23

D. Malpass
J. I. Raffel

Group 25

W. P. Harris

Group 28

J. A. Arnow
J. J. Fitzgerald

Division 3

S. H. Dodd
M. A. Herlin

Group 32

R. E. Hubert
F. L. McNamara
E. F. Tarbox

Group 35

M. Balser

Adams Associates

J. A. Drumheller (3)

Archives

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Lincoln Laboratory, M.I.T.		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP None	
3. REPORT TITLE BASELINE: A Man-Machine Program for Data Analysis			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Note			
5. AUTHOR(S) (Last name, first name, initial) Shannon, George M., Kasnitz, Harold L., Drumheller, John A.			
6. REPORT DATE 20 January 1966		7a. TOTAL NO. OF PAGES 138	7b. NO. OF REFS 1
8a. CONTRACT OR GRANT NO. AF 19(628)-5167		9a. ORIGINATOR'S REPORT NUMBER(S) Technical Note 1966-4	
b. PROJECT NO. ARPA Order 600		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
c.		ESD-TDR-66-19	
d.			
10. AVAILABILITY/LIMITATION NOTICES Distribution of this document is unlimited.			
11. SUPPLEMENTARY NOTES None		12. SPONSORING MILITARY ACTIVITY Advanced Research Projects Agency, Department of Defense	
13. ABSTRACT BASELINE was designed to perform a statistical analysis of radar pulse data previously read by the Laboratory's high precision computer controlled film reader. A computer controlled display oscilloscope, a light pen and a set of function coded sense switches provide a real time interface between an analyst and the data reduction program in the computer. The computer performs all necessary display, computation and outputting functions. All operations are under direct control of the analyst. He sets the operating criteria, exercises the required judgments and steers the program through the required analysis. Analytical results are quickly available and rapidly documented. Output consists of a statistical distribution of the input data displayed on a large oscilloscope. This display may easily be documented photographically. Key parameters describing the statistical distribution may be output on the type-writer at the command of the analyst. A very large saving in the data reduction time results since the necessity of repeated test runs through a large computer and subsequent study of the numerical printouts is eliminated.			
14. KEY WORDS statistical analysis PDP-1 man-machine radar pulse data computer graphics			